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COAST FISHES

PART III. THE ANTARCTIC ZONE

By

J. R. NORMAN
Department of Zoology, British Museum (Natural History)

COAST FISHES

PART III. THE ANTARCTIC ZONE[1]

By J. R. Norman
Department of Zoology, British Museum (Natural History)

(Plate I; Text-figs. 1–62)

INTRODUCTION

The collections dealt with in this, the third and final part of the report on the coast fishes, include about 1500 specimens, representing 42 species, of which five prove to be new to science,[2] and five others were previously unrepresented in the National Collection. The fishes belonging to the division Nototheniiformes are particularly well represented, and, together with the fine series of specimens recently obtained by the B.A.N.Z. Antarctic Research Expedition, and the rich material already in the collection of the British Museum, form an excellent basis for a new revision of this interesting group. Of the 86 species of fish recorded from the Antarctic Zone, no less than 65 (or 75 per cent) belong to the division Nototheniiformes. It may be noted that of these 65 species, 60 (or 92 per cent) are represented in the British Museum: I have been able to examine examples of three more species in Paris and elsewhere, so that only two species are included solely on the evidence of published descriptions. One of these were obtained by the Australasian Antarctic Expedition (1911–1914), and is preserved in the museum at Adelaide, South Australia; the other formed part of the collection made by the 'Gauss' (Deutsche Südpolar-Expedition, 1901–1903), and is presumably to be found in the Berlin Museum. A visit to the Muséum National d'Histoire Naturelle in Paris enabled me to examine a number of specimens obtained by the two French Antarctic Expeditions.

My thanks are due to the members of the Discovery Committee for permission to study these collections and to prepare this report. I am also indebted to Professor J. Pellegrin, Dr C. F. Angel, and Dr P. Chabanaud, for many courtesies during my short stay in Paris; to Dr V. Van Straelen, for kindly allowing me to borrow the unique types of *Gerlachea australis* and *Racovitzia glacialis* preserved in the Musée Royal d'Histoire Naturelle de Belgique; and to Dr H. Rendahl, for the loan of the unique type of *Chionodraco hamatus* preserved in the Naturhistoriska Riksmuseum at Stockholm. To all these gentlemen my thanks are due and are gratefully tendered. I am also indebted to Mr G. C. L. Bertram for allowing me to study the small collection of fishes

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[1] For details as to the limits of this region see p. 87.

[2] Preliminary descriptions of three of these new species were published recently, see Norman, 1937, *Ann. Mag. Nat. Hist.*, (10) xx, p. 475.

made by the British Graham Land Expedition (1934–1937) and for permission to include the names in this report.

The illustrations, as in the earlier parts of this report, are the work of Lieut.-Col. W. P. C. Tenison, D.S.O.

SYSTEMATIC PART

MYXINIDAE

Myxine australis, Jenyns.

1842, *Zool.* '*Beagle*', Fish., p. 159; Norman, 1937, *Discovery Rep.*, XVI, p. 6.

Hab. Coasts of Patagonia and southern Chile; Falkland Islands; South Shetland Islands.

No specimens of this species were obtained by the expedition, but there is one from the South Shetlands in the British Museum collection. This is 230 mm. in total length, and was collected by Mr J. E. Hamilton in 1924.

RAJIDAE

Raja georgiana, sp.n.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. From 8 cables S 81° W of Merton Rock to 1·3 miles N 7° E of Macmahon Rock. Large otter trawl, 179–235 m.: 1 female specimen, 185 mm. (width of disc 140 mm.).

Disc much broader than long, its width about $\frac{4}{5}$ of the total length; anterior margins a little undulated but not emarginate; outer angles rounded. Vent a little nearer to tip of snout than to end of tail. Snout scarcely projecting, its length rather more than $\frac{1}{7}$ width of disc; interorbital width greater than longitudinal diameter of eye and about equal to length of eye+spiracle, which is about 2 in that of snout. Internasal width about $\frac{3}{4}$ praeoral length of snout. Mouth nearly straight; about 24 rows of teeth in upper jaw. Upper surface of disc more or less evenly covered with small spinules; a single praeocular spine and two postocular spines, of which the hinder is the larger; a pair of strong curved scapular spines set one behind the other; a single spine on the median line of the back midway between the second postocular and the first scapular spine, and another level with the posterior scapular spines; a series of similar spines extending in a median line from just behind the suprascapulary region to the first dorsal fin. Lower surface quite smooth. Dorsal fins close to end of tail, their bases contiguous. Pale greyish-brown, mottled and spotted with yellowish-white; hinder margins of pectorals and edges of pelvics with a narrow pale border; lower surface yellowish-white, with a dusky tinge towards the hinder parts of the pectorals and pelvics.

Hab. South Georgia.

This species appears to be most nearly related to *R. macloviana*, Norman, from the Patagonian region, and *R. murrayi*, Günther, from Kerguelen, but differs from both in the shape of the disc, in the smaller eyes, in the greater internasal width, and in the form and arrangement of the spines. It may, of course, prove to be identical with *R. arctowskii*, Dollo, the only other species of *Raja* described from the Glacial District (see below).

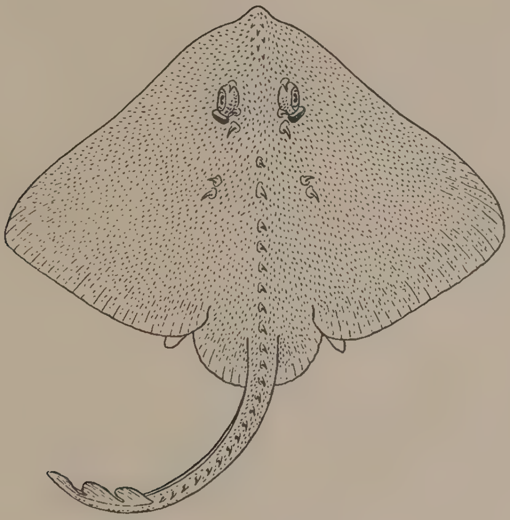

Fig. 1. *Raja georgiana*. Holotype. × ½.

Raja arctowskii, Dollo.

1904, *Rés. Voy. 'Belgica'*, Poiss., p. 52, pl. ix, fig. 10.

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island, 61° 25′ 30″ S, 53° 46′ 00″ W. Large dredge, 342 m.: 6 egg-capsules.

Hab. Bellingshausen Sea; between South Shetlands and South Orkneys.

Dollo's original description of this species was based upon three egg-capsules, each 60 mm. in length (without the horns), from 70° 15′ S, 84° 06′ W; 70° 23′ S, 82° 47′ W; and 71° 19′ S, 87° 37′ W; at depths ranging from 400 to 569 metres. The fish itself has not yet been recognized.

Raja sp.

St. 599. 17. i. 31. 67° 08′ S, 69° 06·5′ W. Large dredge, 203 m.: 1 large egg-capsule with contained embryo.

Hab. Graham Land.

The length of this capsule, without the horns, is about 200 mm., the greatest width about 80 mm. The embryo is 160 mm. in total length and measures 70 mm. across the disc. In general form the capsule is very similar to that of the European Skate, *Raja batis*, Linnaeus.

Other species of *Raja* from the Antarctic Zone are *R. murrayi*, Günther and *R. eatonii*, Günther, both from Kerguelen.

MURAENOLEPIDAE

Muraenolepis microps, Lönnberg.

Muraenolepis marmoratus microps, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 43.

Muraenolepis microps, Regan, 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool., I (1), p. 1, pl. ii, fig. 2; Norman, 1937, *Discovery Rep.*, xvi, p. 58.

St. MS 10. 14. ii. 25. East Cumberland Bay, South Georgia. Small beam trawl, 26–18 m.: 1 specimen, 110 mm.

St. MS —. 28. ix. 25. Grytviken, South Georgia. From kelp root. 2 specimens, 50, 52 mm.

St. MS 68. 2. iii. 26. East Cumberland Bay, South Georgia. Large rectangular net, 220–247 m.: 1 specimen, 285 mm.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 4 specimens, 105–260 mm.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: 2 specimens, 130, 158 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 270–238 m.: 6 specimens, 150–335 mm.

St. 46. 6. iv. 26. 51° 13′ 00″ S, 49° 50′ 00″ W. Large otter trawl, 270–238 m.: 1 specimen, 305 mm.

St. 123. 15. xii. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 230–250 m.: 4 specimens, 248–300 mm.

St. WS 25. 17. xii. 26. Undine Harbour (North), South Georgia. Small beam trawl, 18–27 m.: 1 specimen, 50 mm.

St. 140. 23. xii. 26. Stromness Harbour to Larsen Point, South Georgia. Large otter trawl, 122–136 m.: 1 specimen, 120 mm.

St. 142. 30. xii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 88–273 m.: 1 specimen, 142 mm.

St. 148. 9. i. 27. Off Cape Saunders, South Georgia. Large otter trawl, 132–148 m.: 2 specimens, 235, 290 mm.

St. WS 424. 14. iv. 29. 54° 34′ 00″ S, 38° 49′ 00″ W. 1 m. tow-net, oblique, 95–0 m.: 1 specimen, 39 mm.

St. —. 29. i. 35. Grytviken, South Georgia. Large gauze fish trap. 1 specimen, 320 mm.

St. 1660. 27. i. 36. 74° 46·4′ S, 178° 23·4′ E. Large otter trawl, 351 m.: 1 specimen, 220 mm.

Depth of body $4\frac{3}{4}$ to 6 in the length, length of head $4\frac{1}{2}$ to $5\frac{1}{4}$. Snout $1\frac{1}{2}$ times to twice as long as eye, diameter of which is 4 (young) to 6 in length of head, equal to or less than interocular width, and greater than interorbital width. Barbel $\frac{1}{5}$ or $\frac{1}{6}$ length of head. Maxillary extending to below anterior part of eye in young, to middle of eye or beyond in larger specimens. Dorsal filament varying from $\frac{2}{3}$ to about twice diameter of eye, inserted above or a little behind base of pectoral. Origin of anal only a little nearer to end of snout than to base of caudal. Length of pectoral $\frac{1}{2}$ to $\frac{3}{5}$, of pelvic $\frac{3}{4}$ to $\frac{5}{6}$ that of head; pelvic inserted well in advance of base of pectoral. Uniformly greyish or brownish.

Hab. Burdwood Bank, south of the Falkland Islands; South Georgia; South Sandwich Islands; South Victoria Land.

This species was originally described from 4 specimens, 140 to 335 mm. in total length, from Cumberland Bay, South Georgia, at depths of 20 to 100 metres.

Examination of this fine series of specimens shows that *M. microps* is very closely related to *M. marmoratus*, Günther, from Kerguelen, and may even prove to be identical with that species. Comparison of examples of equal size, however, suggests that *M. marmoratus* has a smaller head, a slightly larger eye, and perhaps a shorter dorsal filament.

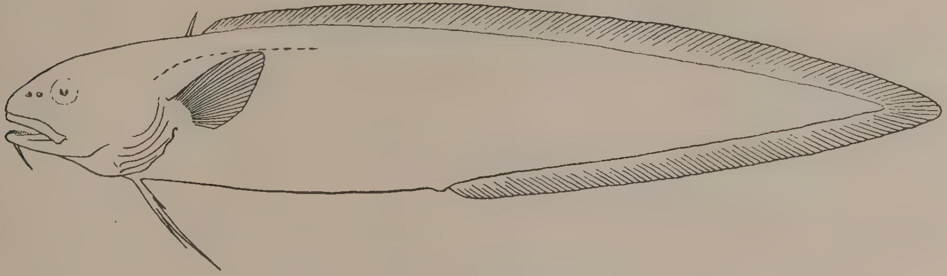

Fig. 2. *Muraenolepis microps*. × ½.

The only other species of *Muraenolepis* from the Antarctic Zone is *M. microcephalus*, Norman, known only from the unique holotype, 125 mm. in total length, from 63° 51′ S., 54° 16′ E (2000 metres of wire), collected by the B.A.N.Z. Antarctic Research Expedition. This form appears to be most nearly related to *M. orangiensis*, Vaillant, from the Patagonian region. I have given a key to the four known species of *Muraenolepis* elsewhere.[1]

REVISION OF THE ANTARCTIC NOTOTHENIIFORMES

Regan's revision published in 1913,[2] together with his subsequent report on the rich material collected by the 'Terra Nova',[3] has placed the taxonomy of this group of fishes on a sound basis. In more recent years, however, the Australasian Antarctic Expedition of 1911–1914, and the British, Australian, New Zealand Antarctic Research Expedition of 1929–1931, together with the important collections of the Discovery Committee, have brought to light a number of additional forms, and have added considerably to our knowledge of the fish fauna of the Antarctic Zone.[4] The problems raised by the study of this material have led me to undertake a new revision of these fishes, which, although it amplifies that of Regan, only modifies his conclusions in certain comparatively unimportant details.

Division NOTOTHENIIFORMES

Percoid fishes, normally without pungent fin-spines, with the spinous dorsal, when developed, shorter than the long soft dorsal and anal, the principal caudal rays reduced in number (usually 14), the pectorals typically broad-based, and the pelvics jugular, separated by an interspace, and each formed of a spine and 5 branched rays. There is a single nostril on each side. In osteological characters the more generalized forms are very similar to the Perciformes, but the structure and position of the radials of the pectoral fins are highly characteristic. The radials are 3 in number, rather large flat plates; all or 2 are inserted on the hypocoracoid, and the lowest is the narrowest and has its lower edge in contact with the metapterygoid process. [After Regan.]

---

[1] Norman, 1937. *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 69.

[2] *Trans. R. Soc. Edinburgh*, XLIX, pp. 249–289.

[3] 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. I (1), pp. 1–54.

[4] This Zone includes the Glacial District and the Kerguelen District, see Regan, 1914, *t.c.*, pp. 33–36.

Five families, of which one (Bovichthyidae) does not occur in the Antarctic Zone.

Synopsis of the Antarctic Families

I. Palatines and pterygoids normally developed; ribs present.
  A. Spinous dorsal fin present; mouth protractile.
    1. Operculum normal; body scaly; gill-membranes forming a fold across the isthmus 1. *Nototheniidae.*
    2. Operculum hooked upwards posteriorly, its upper edge deeply concave; body naked; gill-membranes broadly united to isthmus ... ... 2. *Harpagiferidae.*
  B. Spinous dorsal fin absent; mouth usually non-protractile ... ... 3. *Bathydraconidae.*
II. Palatine in great part ligamentous; no mesopterygoid; mouth not protractile; snout produced and depressed; ribs not ossified ... ... 4. *Chaenichthyidae.*

Family NOTOTHENIIDAE

Body scaly. Snout not or only a little produced. Mouth protractile; palatines and pterygoids normally developed; palate toothless. Gill-membranes forming a fold across the isthmus; operculum normal. Spinous dorsal fin present. All three radials situated on the hypocoracoid. Ribs present.

Five genera, of which one (*Eleginops*) does not occur in the Antarctic Zone.

Key to the Antarctic Genera

I. Foramen partly bordered by hypocoracoid (fig. 3 B) ... ... 1. *Notothenia.*
II. Hypercoracoid enclosing its foramen (fig. 3 A).
  A. Scales not very thin, those of upper lateral line with tubules, those of lower lateral line with tubules or pits; two lateral lines; skeleton well ossified; most of the praecaudal vertebrae with parapophyses
    1. Teeth in bands, villiform; snout not much longer than eye ... 2. *Trematomus.*
    2. Teeth in upper jaw biserial, those of outer row enlarged, spaced, canine-like; a group of stronger teeth on each praemaxillary; teeth of lower jaw uniserial, spaced, canine-like; snout much longer than eye ... ... 3. *Dissostichus.*
  B. Scales very thin, cycloid, those of the 3 lateral lines each with a notched hinder margin and with a vertical row of 3 shallow pits; skeleton feebly ossified; only the posterior praecaudal vertebrae with parapophyses ... ... 4. *Pleuragramma.*

Genus NOTOTHENIA

Notothenia, Richardson, 1844, *Zool. 'Erebus' and 'Terror'* (Fish.), p. 5; Günther, 1860, *Cat. Fish.*, II, p. 260; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 264. Type *Notothenia coriiceps*, Richardson.

Macronotothen, Gill, 1862, *Proc. Acad. N.S. Philad.* (1861), p. 520. Type *Notothenia*? *rossii*, Richardson.

? *Pagothenia*, Nichols and LaMonte, 1936, *Amer. Mus. Novit.*, 839, p. 2. Type *Pagothenia antarctica*, Nichols and LaMonte.

Body scaly; two lateral lines with tubular or pitted scales. Mouth of moderate size or rather large; teeth usually in bands, but sometimes irregularly bi- or tri-serial with some of the teeth of the outer series enlarged and canine-like. Snout not much longer than the eye. Gill-membranes united, free or forming a free fold across the isthmus. Pectoral fin rounded or vertically truncated. Skeleton well ossified; vertebrae 44 to 54 (16–20+27–34); most of the praecaudals with parapophyses to which the ribs and epipleurals are attached; hypercoracoid foramen margined below by the hypocoracoid.

Coasts of the Antarctic Continent and northwards to Patagonia, Chile, the Falkland Islands, South Georgia, Bouvet Island, Marion Islands, Crozet Islands, Kerguelen, Macquarie Island, southern New Zealand, and Chatham Islands.

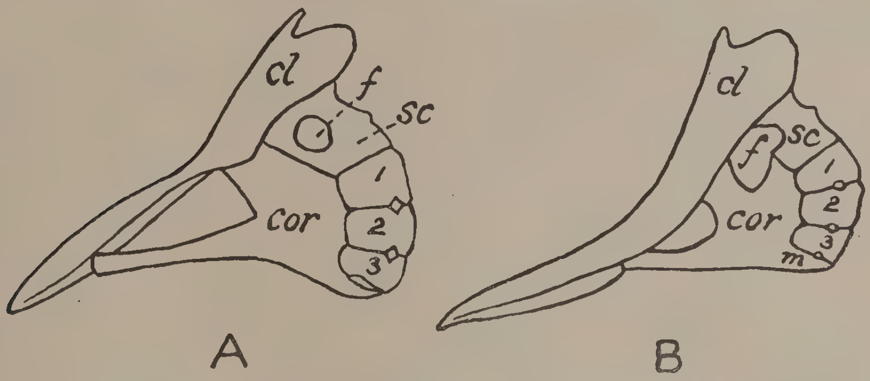

Fig. 3. Pectoral fin-skeleton of A, *Trematomus newnesi*; B, *Notothenia coriiceps*. *cl*, cleithrum; *sc*, hypercoracoid (scapula); *f*, foramen; *cor*, hypocoracoid; *m*, metapterygoid process; 1, 2, 3, radials. (After Regan.)

Key to the Antarctic Species

I. Cheeks and opercles largely scaled, the scaling extending downwards for at least half the depth of the operculum; upper surface of head scaly (except in *N. nudifrons*).

A. Pectoral with 21 to 25 rays; dorsal IV–VIII, 31–41; anal 30–40.

1. Snout and praeorbital scaly (except in young); 12 to 17 gill-rakers on lower part of anterior arch.

a. Upper lateral line of 39 to 47 tubular scales; similar scales generally present in lower lateral line; depth 4 to $4\frac{4}{5}$ in length.

α. Eye 3 to $3\frac{1}{2}$, interorbital width 9 to 12 in head; dorsal IV–V, 36–37; anal 32; 15 to 18 tubular scales in lower lateral line ... ... 1. *squamifrons.*

β. Eye 3, interorbital width 9 in head; dorsal VI, 34; anal 30; 4 to 8 tubular scales in lower lateral line ... ... 2. *macrophthalma.*

γ. Eye $2\frac{2}{3}$ to $3\frac{1}{3}$, interorbital width 14 to 16 in head; dorsal V–VI, 36–38; anal 32–33; usually 9 to 17 tubular scales in lower lateral line ... ... 3. *kempi.*

b. Upper lateral line of 46 to 58 tubular scales; no tubular scales in lower lateral line; depth $4\frac{1}{3}$ to $5\frac{3}{4}$ in length; dorsal IV–VI, 35–41; anal 36–40 ... ... 4. *larseni.*

2. Praeorbital naked; snout naked or scaly; 8 to 13 gill-rakers on lower part of anterior arch.

a. 30 to 42 tubular scales in lower lateral line (except in young); pelvics shorter than pectorals, scarcely reaching as far as vent; dorsal VII–VIII, 31–34; anal 31–34 ... ... 5. *gibberifrons.*

b. Lower lateral line without tubular scales; pelvics longer than pectorals, extending as far as vent or anal fin.

α. Upper surface of head scaly; dorsal IV–V, 34–37; anal 33–35 6. *mizops.*

β. Upper surface of head naked; dorsal IV–VI, 36–40; anal 34–36 7. *nudifrons.*

B. Pectoral with 19 to 21 rays; dorsal V–VII, 28–31; anal 27–31.

1. Opercles fully scaled; pelvics reaching as far as vent; 54 to 60 scales in a longitudinal series; upper lateral line of 36 to 39 tubular scales ... ... 8. *acuta.*

2. Opercles scaly above, naked below; pelvics not reaching as far as vent; 46 to 52 scales in a longitudinal series; upper lateral line of 26 to 35 tubular scales.

a. Interorbital width 15 to 20 in head; dorsal V–VIII, 28–30; anal 29–31. 9. *angustifrons.*

b. Interorbital width 10 in head; dorsal VII, 29; anal 27 ... ... 10. *marionensis.*

II. Opercles scaled only on upper part of operculum; upper surface of head naked.

A. Anal of 26 to 34 rays.

1. Interorbital width 5 to $6\frac{1}{2}$ in head; pectoral with 20 or 21 rays; cheek scaly below and behind eye, its lower $\frac{1}{2}$ (young) or $\frac{1}{4}$ (adult) naked; dorsal IV–VI, 33–36; anal 30–34; scales ctenoid on body ... ... 11. *cyanobrancha.*

2. Interorbital width $3\frac{2}{3}$ to 5 in head; pectoral with 17 or 18 rays; cheek scaly behind eye; dorsal III–VII, 35–40; anal 27–31; scales cycloid on body 12. *coriiceps.*

3. Interorbital width $2\frac{3}{4}$ to $3\frac{3}{4}$ in head; pectoral with 21 to 23 rays; cheek scaly behind and to some extent below eye; dorsal IV–VII, 32–36; anal 26–30; scales cycloid on body ... ... 13. *rossii.*

B. Anal of 22 to 25 rays; interorbital width $2\frac{1}{2}$ to 4 in head.

1. Dorsal III–VI, 29–31; 50 to 60 scales in a lateral longitudinal series 14. *macrocephala.*

2. Dorsal VI–VIII, 26–27; 84 to 92 scales in a lateral longitudinal series 15. *colbecki.*

It has proved impossible to ascertain the true position of *Notothenia phocae*, Richardson (1844, *Zool. 'Erebus' and 'Terror'* (Fish.), p. 8), and this must remain a doubtful species. The examples mentioned by Richardson as having been preserved in spirits no longer exist, and I have been unable to trace the drawing said to have been made by Dr Hooker. The fish were all taken at 65° S, *circa* 155° W, from the stomach of a seal, and ranged in size from 65 to 170 mm. in length (without the caudal fin).

Notothenia squamifrons, Günther.

Notothenia squamifrons, Günther, 1880, *Shore Fish. 'Challenger'*, p. 16, pl. viii, fig. C; Regan, 1913, *t.c.*, p. 270.

Depth of body $4\frac{1}{2}$ in the length, length of head $3\frac{3}{5}$. Snout shorter than eye, diameter of which is 3 to $3\frac{1}{2}$ in length of head; interorbital width 9 to 12. Jaws equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ of eye; upper surface and sides of head, including snout and praeorbital, scaly; about 5 rows of scales between the eyes; 14 to 16 gill-rakers on lower part of anterior arch. Scales on body cycloid or feebly ctenoid; 55 in a longitudinal series from above base of pectoral to caudal, 44 or 45 in upper lateral line, which terminates below end of dorsal, or just behind it, 15 to 18 in lower lateral line. Dorsal IV–V, 36–37. Anal 32. Pectoral with 24 or 25 rays, ¾ length of head, rather shorter than pelvics, which reach the anal. Caudal peduncle deeper than long. Body with irregular cross-bars; cheek with two oblique stripes; spinous dorsal partly blackish.

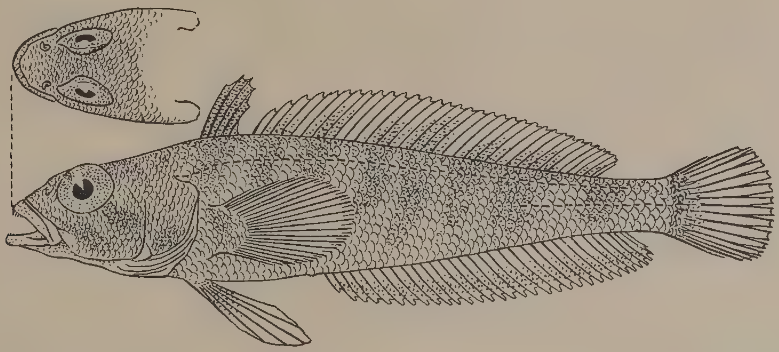

Fig. 4. *Notothenia squamifrons*. × ¾.

Hab. Kerguelen.

Known only from the types of the species, two specimens, 110 and 150 mm. in total length.

Notothenia macrophthalma, Norman.

Notothenia macrophthalma, Norman, 1937, *Discovery Rep.*, XVI, p. 68, fig. 30.

Very closely related to the preceding species, but diameter of eye 3 in length of head; 3 rows of scales between the eyes; 12 gill-rakers on lower part of anterior arch; only 4 to 8 tubular scales in lower lateral line; dorsal VI, 34; anal 30.

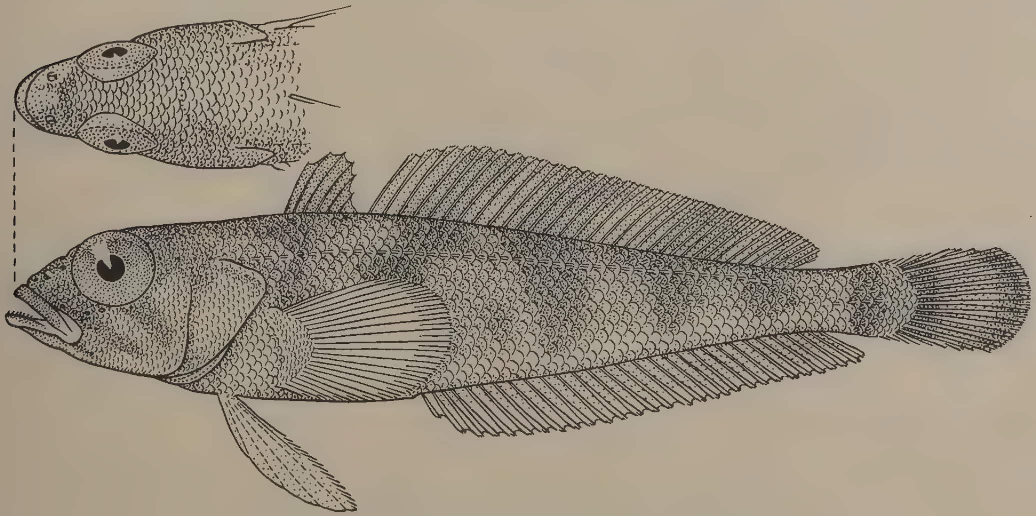

Fig. 5. *Notothenia macrophthalma*. Holotype. × ⅘.

Hab. Near the Burdwood Bank, south of the Falkland Islands.

A full description of this species, which is known only from the unique holotype (190 mm. in total length), has been given in a previous report, but, since it seems to be more nearly related to Antarctic than to Patagonian species of *Notothenia*, I have included it again here.

Notothenia kempi, Norman.

Notothenia kempi, Norman, 1937, *Ann. Mag. Nat. Hist.*, (10) xx, p. 475.

St. 180. 11. ii. 27. 1·7 miles W of North point of Gand Island, Schollaert Channel, Palmer Archipelago. Large dredge, 160 m.: 1 specimen, 88 mm.

St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago. Large otter trawl, with nets (4 mm. and 7 mm. mesh) attached, 160–335 m.: 8 specimens, 80–235 mm.

St. 182. 14. iii. 27. Schollaert Channel, Palmer Archipelago. Large otter trawl, 278–500 m.: 1 specimen, 210 mm. Holotype.

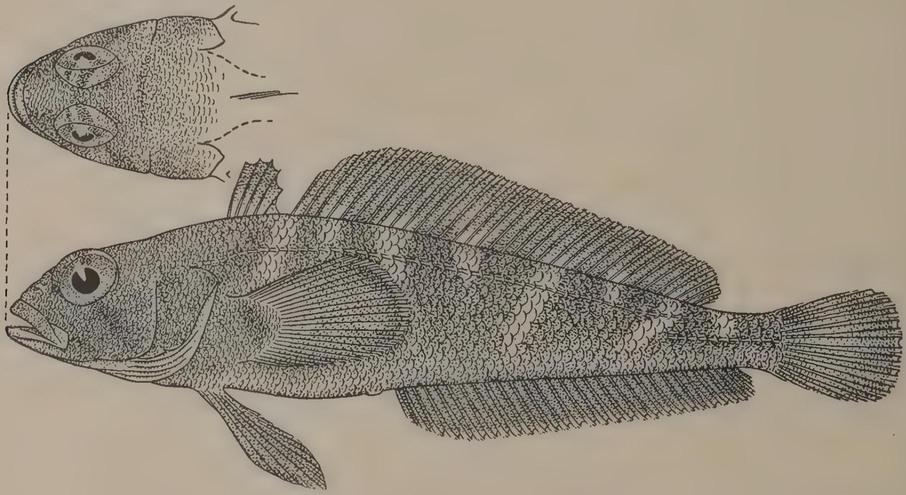

Fig. 6. *Notothenia kempi*. Holotype. × $\frac{5}{8}$.

Depth of body 4 to $4\frac{4}{5}$ in the length, length of head $3\frac{2}{5}$ to $3\frac{3}{5}$. Snout shorter than eye, diameter of which is $2\frac{2}{3}$ to $3\frac{1}{3}$ in length of head; interorbital width 14 to 16. Jaws equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ of eye; upper surface and sides of head, including snout and praeorbital, scaly in adult; snout and praeorbital partly or entirely naked in young; upper surface of eyeball scaly in adult; 2 or 3 rows of scales between the eyes; 12 to 14 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 55 to 59 in a longitudinal series from above base of pectoral to caudal; 40 to 47 in upper lateral line, which terminates below posterior rays of dorsal or a little farther back, 9 to 17 in lower lateral line. Dorsal V–VI, 36–38. Anal 32–33. Pectoral with about 25 rays, $\frac{3}{4}$ to $\frac{4}{5}$ length of head, as long as or a little longer than pelvics, which reach to or nearly to vent in adults, sometimes beyond in young. Caudal subtruncate or a little rounded; caudal peduncle deeper than long. Body with broad irregular cross-bars, which extend on to the base of the dorsal fin; cheek with two oblique dark stripes; spinous dorsal with a black blotch; soft dorsal with a submarginal blackish band, which in adults covers the greater part of the fin; anal fin blackish in adults, the margin narrowly white; the whole anal fin pale in young; caudal, pectorals and pelvics all more or less dusky in adults, with somewhat narrow pale margins.

Hab. Palmer Archipelago, Graham Land.

This well-marked species was named after Dr Stanley W. Kemp, F.R.S., the former Director of Research.

Notothenia larseni, Lönnberg.

Notothenia larseni, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), pp. 31, 46, pl. i, fig. 3, pl. ii, fig. 6; Regan, 1913, *t.c.*, p. 272.

St. MS 67. 28. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 38 m.: 1 specimen, 43 mm.

St. MS 71. 9. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 110–60 m.: 21 specimens, 60–80 mm.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 6 specimens, 65–102 mm.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: numerous specimens, 52–195 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 238–270 m.: 135 specimens, 60–185 mm.

St. 123. 15. xii. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, with tow-net attached, 230–250 m.: 14 specimens, 52–104 mm.

St. 140. 23. xii. 26. Stromness Harbour to Larsen Point, South Georgia. Large otter trawl, 122–136 m.: 8 specimens, 60–123 mm.

St. 142. 30. xii. 26. East Cumberland Bay, South Georgia. Net (7 mm. mesh) attached to back of trawl, 88–273 m.: 3 specimens, 115–145 mm.

St. 144. 5. i. 27. Off mouth of Stromness Harbour, South Georgia. Net (4 mm. mesh) attached to back of trawl, 155–178 m.: 3 specimens, 60–86 mm.

St. WS 42. 7. i. 27. 54° 41′ 45″ S, 36° 47′ 00″ W. 1 m. tow-net, horizontal, 198 m.: 1 specimen, 163 mm.

St. 148. 9. i. 27. Off Cape Saunders, South Georgia. Large otter trawl, with net (4 mm. mesh) attached, 132–148 m.: 13 specimens, 58–104 mm.

St. 149. 10. i. 27. Mouth of East Cumberland Bay, South Georgia. Large otter trawl, 200–234 m.: 4 specimens, 150–170 mm.

St. WS 62. 19. i. 27. Wilson Harbour, South Georgia. Small beam trawl, 26–83 m.: 45 specimens, 57–64 mm.

St. 156. 20. i. 27. 53° 51′ 00″ S, 36° 21′ 30″ W. Large dredge, 200–236 m.: 1 specimen, 160 mm.

St. 160. 7. ii. 27. Near Shag Rocks, 53° 43′ 40″ S, 40° 57′ 00″ W. Large dredge, 177 m.: 2 specimens, 70, 72 mm.

St. 167. 20. ii. 27. Off Signy Island, South Orkneys. Net (7 mm. mesh) attached to back of trawl, 244–344 m.: 13 specimens, 123–176 mm.

St. 175. 2. iii. 27. Bransfield Strait, South Shetlands. Large dredge, 200 m.: 2 specimens, 170, 170 mm.

St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago. Nets (4 mm. and 7 mm. mesh) attached to back of trawl, 160–335 m.: 17 specimens, 100–153 mm.

St. WS 165. 1. iii. 28. 53° 44′ S, 38° 46′ W. 70 cm. tow-net, oblique, 133–0 m.: 1 specimen, 93 mm.

St. WS 179. 7. iii. 28. 55° 08′ 00″ S, 35° 20′ 00″ W. 1 m. tow-net, oblique, 112–0 m.: 1 specimen, 72 mm.

St. WS 358. 13–14. i. 29. 55° 02′ 30″ S, 35° 18′ 00″ W. 1 m. tow-net, oblique, 85–0 m.: 1 specimen, 53 mm.

St. 341. 5–6. ii. 30. 54° 43′ S, 36° 42½′ W. 1 m. tow-net, oblique, 111–0 m.: 1 specimen, 172 mm.

St. 366. 6. iii. 30. 4 cables S of Cook Island, South Sandwich Islands. Large dredge, 155–322 m.: 10 specimens, 52–110 mm.

St. 371. 14. iii. 30. 1 mile E of Montagu Island, South Sandwich Islands. Large otter trawl, with nets (4 mm. and 7 mm. mesh) attached, 99–161 m.: 17 specimens, 65–195 mm.

St. 456. 18. x. 30. 1 mile E of Bouvet Island. Large dredge, 40–45 m.: 40 specimens, 90–190 mm.

St. 474. 12. xi. 30. 1 mile W of Shag Rocks, South Georgia. Large dredge, 199 m.: 4 specimens, 63–70 mm.

St. 476. 12. xi. 30. 1 mile N of Shag Rocks, South Georgia. 1 m. tow-net, oblique, 165 m.: 6 specimens, 63–72 mm.

St. 1873. 13. xi. 36. 61° 20·8′ S, 54° 04·2′ W. Rectangular dredge, with Russell net, 117 m.: 1 specimen, 200 mm.; 210–180 m.: 4 specimens, 85–190 mm.

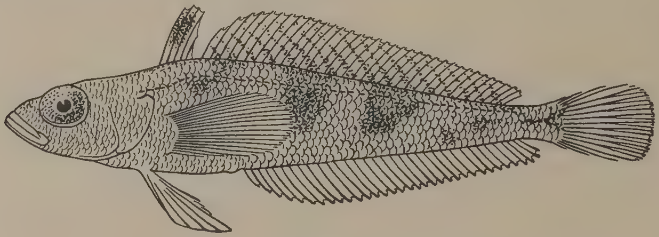

Fig. 7. *Notothenia larseni*. × ½.

Depth of body $4\frac{1}{3}$ to $5\frac{3}{4}$ in the length, length of head $3\frac{1}{3}$ to nearly 4. Snout shorter than eye, diameter of which is $2\frac{4}{5}$ to $3\frac{1}{4}$ in length of head; interorbital width 11 to 13. Jaws equal anteriorly; maxillary extending to or a little beyond vertical from anterior margin of eye; upper surface and sides of head, including snout and praeorbital, scaly in adult, snout and praeorbital often partly or entirely naked in young; 14 to 17 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 58 to 65 in a longitudinal series from above base of pectoral to caudal; 46 to 58 in upper lateral line, which extends beyond end of dorsal; lower lateral line without tubular scales. Dorsal IV–VI, 35–41. Anal 36–40. Pectoral with 23 to 26 rays, about $\frac{4}{5}$ length of head, a little longer than pelvics, which just reach the anal. Caudal subtruncate or a little rounded; caudal peduncle about as long as deep. Body with some irregular oblique dark cross-bars, which in the young tend to break up into 3 or 4 series of alternating spots or blotches; distal part of spinous dorsal with a black blotch; soft dorsal with oblique dark stripes or series of spots; anal plain or similarly marked; caudal often with indistinct dark cross-bars, sometimes dusky distally; pectoral more or less dusky, with pale posterior margin.

Hab. Palmer Archipelago, Graham Land; South Shetlands; South Orkneys; South Georgia; South Sandwich Islands; Bouvet Island.

Lönnberg described this species from 8 specimens: 1 from the Shag Rocks, 5 from outside Cumberland Bay, South Georgia, and 2 from south of Snow Hill; at depths ranging from 250 to 310 metres. It was named after Capt. C. A. Larsen, the chief navigator of the Swedish Antarctic Expedition. Although nearly the commonest species obtained in this region by the Discovery Committee, *N. larseni* was not previously represented in the British Museum collection.

Notothenia gibberifrons, Lönnberg.

Notothenia gibberifrons, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 33, pl. iii, fig. 10; Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 3, p. 139; 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 33; Lönnberg, 1906, *K. Svensk. Vet.-Akad. Handl.*, XL (5), p. 93; Regan, 1913, *t.c.*, pp. 240, 271.

Notothenia acuta, Vaillant, 1906, *t.c.*, p. 139; 1906, *t.c.*, p. 31.

Notothenia vaillanti, Regan, 1913, *t.c.*, p. 272.

St. MS 24. 13. iv. 25. East Cumberland Bay, South Georgia. Small beam trawl, 30 m.: 2 specimens, 33, 38 mm.

St. MS 32. 1. v. 25. East Cumberland Bay, South Georgia. Small beam trawl, 40 m.: 44 specimens, 39–210 mm.

St. —. Feb., 1926. Cumberland Bay, South Georgia. Long line: 1 specimen, 223 mm.

St. MS 63. 24. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 23 m.: 1 specimen, 145 mm.

St. MS 67. 28. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 38 m.: 2 specimens, 65, 85 mm.

St. MS 71. 9. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 110–60 m.: 3 specimens, 130–225 mm.

St. MS 74. 17. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 22–40 m.: 2 specimens, 33, 38 mm.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 23 specimens, 38–400 mm.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: 30 specimens, 35–280 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 270–238 m.: 27 specimens, 36–335 mm.

St. 123. 15. xii. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 230–250 m.: 3 specimens, 61–300 mm.

St. 140. 23. xii. 26. Stromness Harbour to Larsen Point, South Georgia. Large otter trawl, 122–136 m.: 4 specimens, 68–145 mm.

St. WS 62. 19. i. 27. Wilson Harbour, South Georgia. Small beam trawl, 26–83 m.: 72 specimens, 47–100 mm.; small beam trawl, 15–45 m.: 3 specimens, 50–53 mm.

St. 167. 20. ii. 27. Off Signy Island, South Orkneys. Net (7 mm. mesh) attached to back of trawl, 244–344 m.: 16 specimens, 142–270 mm.

St. 189. 23–25. iii. 27. Port Lockroy, Wiencke Island, Palmer Archipelago. Large fish trap, 70 m.: 6 specimens, 265–375 mm.

St. WS 358. 13–14. i. 28. 55° 02′ 30″ S, 35° 18′ 00″ W. 1 m. tow-net, oblique, 85–0 m.: 1 specimen, 57 mm.

St. 371. 14. iii. 30. 1 mile E of Montagu Island, South Sandwich Islands. Large otter trawl, with nets (4 mm. and 7 mm. mesh) attached, 99–161 m.: 6 specimens, 170–210 mm.

St. 393 c. 8. v. 30. 54° 17′ S, 35° 30′ W. 1 m. tow-net, oblique, 121–187 m.: 1 specimen, 39 mm.
No data. 2 specimens, 325, 330 mm.

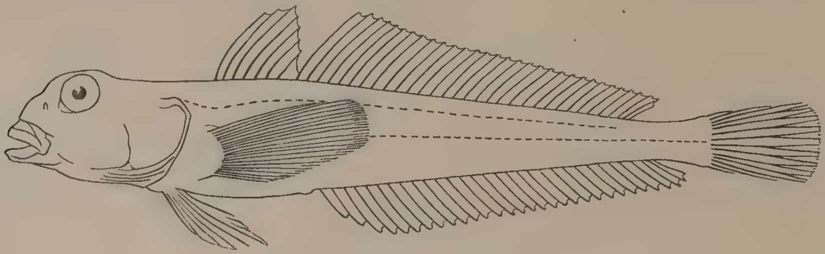

Fig. 8. *Notothenia gibberifrons*. × $\frac{2}{5}$.

Depth of body 5 to $5\frac{1}{2}$ in the length, length of head $3\frac{1}{4}$ to $3\frac{4}{5}$. Snout as long as or rather shorter than eye, diameter of which is 3 (young) to $4\frac{2}{3}$ in length of head; interorbital width 12 to 16. Jaws equal anteriorly; maxillary not or only just reaching vertical from anterior margin of eye; cheeks, opercles, upper surface of head, and greater part of snout scaly in adult, but praeorbitals naked; 8 to 11 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 54 to 60 in a longitudinal series from above base of pectoral to caudal; 34 to 47 (51) in upper lateral line, which ends below posterior part of dorsal; 30 to 42 in lower lateral line, which generally extends forward to or beyond level of tip of pectoral; lower lateral line usually without tubular scales in young. Dorsal VII–VIII, 31–34. Anal 31–34. Pectoral with 21 or 22 rays, $\frac{4}{5}$ to $\frac{7}{8}$ length of head, longer than pelvics, which reach vent or origin of anal in young, but not or scarcely as far as vent in adult. Caudal rounded or subtruncate; caudal peduncle about as long as deep. Upper part of head and body irregularly spotted and blotched, but only rarely with traces of darker cross-bars; young with irregular cross-bars, broken up into 3 or 4 series of alternating spots; usually a more distinct Y-shaped mark at base of caudal; dorsals, caudal, pectorals and sometimes the pelvics with series of dark spots forming bars; anal pale.

Hab. Palmer Archipelago, Graham Land; South Shetlands; South Orkneys; South Sandwich Islands; South Georgia.

This species was originally described from numerous specimens, all from South Georgia, at depths ranging from 20 to 310 metres. According to Lönnberg, it is a sluggish bottom fish, but the Discovery Committee obtained some young examples in tow-nets. Lönnberg records a specimen 460 mm. in total length.

The large specimen, 410 mm. in total length, described by Vaillant as *Notothenia acuta*, has been examined by me in the Paris Museum (No. 06—132), and undoubtedly belongs to this species. There are also two small specimens (No. 06—131), 53 and 56 mm. in total length, the larger of which is the holotype of *N. vaillanti*, Regan. These prove to be young *N. gibberifrons*, in which the snout is always more or less naked and the tubular scales in the lower lateral line are usually absent. The 'Français' obtained these specimens from Booth Wandel Island and Wiencke Island, at depths varying from 20 to 40 metres.

Notothenia mizops, Günther.

Notothenia mizops, Günther, 1880, *Shore Fish. 'Challenger'*, p. 16, pl. viii, fig. D; Regan, 1913, *t.c.*, p. 273; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 61.

Depth of body 4⅓ to 4¾ in the length, length of head 3 (young) to 4. Snout much shorter than eye, diameter of which is 3 to 3½ in length of head; interorbital width about 15. Jaws equal anteriorly; maxillary extending to below anterior ¼ or ⅓ of eye; cheeks, opercles occiput and interorbital region scaly; 9 to 13 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 48 to 55 in a longitudinal series from above base of pectoral to caudal; 30 to 38 in upper lateral line, which ends below posterior part of dorsal; lower lateral line without tubular scales. Dorsal IV–V, 34–37. Anal 33–35. Pectoral with 21 or 22 rays, ⅔ to ⅞ length of head, shorter than pelvics, which extend to, nearly to, or beyond origin of anal. Caudal rounded; caudal peduncle deeper than long. Body with two series of large, partly confluent, irregular blackish spots; cheek with two oblique dark stripes; a blackish spot on spinous dorsal; soft dorsal, caudal and anal with or without series of dark spots.

Hab. Kerguelen.

The above description is based upon the types of the species, 5 specimens, 70 to 170 mm. in total length, from off Christmas Harbour and Howes Foreland, 220 metres; and upon 10 specimens, 40 to 145 mm. in total length, collected by the B.A.N.Z. Antarctic Research Expedition, at depths ranging from 20 to 150 metres.

Notothenia nudifrons, Lönnberg.

Notothenia mizops var. *nudifrons*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), pp. 30, 45, pl. i, fig. 2; Lönnberg, 1906, *K. Svensk. Vet.-Akad. Handl.*, XL (5), p. 92; Roule and Despax, 1911, *Bull. Mus. Paris*, 1911, No. 5, p. 278; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 4.

Notothenia mizops, Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 3, p. 139; 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 30.

Notothenia nudifrons, Regan, 1913, *t.c.*, pp. 240, 273.

St. MS 6. 14. ii. 25. East Cumberland Bay, South Georgia. Small beam trawl, 24–30 m.: 4 specimens, 38–220 mm.

St. MS 10. 14. ii. 25. East Cumberland Bay, South Georgia. Small beam trawl, 26–18 m.: 11 specimens, 47–133 mm.

St. MS 12. 17. ii. 25. East Cumberland Bay, South Georgia. Small beam trawl, 25 m.: 1 specimen, 105 mm.

St. MS 25. 13. iv. 25. East Cumberland Bay, South Georgia. Small beam trawl, 36 m.: 2 specimens, 50, 80 mm.

St. MS 32. 1. v. 25. East Cumberland Bay, South Georgia. Small beam trawl, 40 m.: 2 specimens, 94, 142 mm.

St. MS 33. 1. v. 25. 1 cable E of Hobart Rock, East Cumberland Bay, South Georgia. Small beam trawl, 40 m.: 1 specimen, 95 mm.

St. MS 62. 24. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 31 m.: 6 specimens, 40–84 mm.

St. MS 63. 24. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 23 m.: 6 specimens, 37–67 mm.

St. MS 67. 28. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 38 m.: 8 specimens, 42–185 mm.

St. MS 71. 9. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, with tow-net of coarse silk attached, 110–60 m.: 26 specimens, 42–150 mm.

St. MS 74. 17. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 22–40 m.: 18 specimens, 14–158 mm.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 3 specimens, 130–150 mm.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: 3 specimens, 52–66 mm.

St. WS 25. 17. xii. 26. Undine Harbour (North), South Georgia. Small beam trawl, 18–27 m.: 45 specimens, 40–145 mm.

St. 140. 23. xii. 26. Stromness Harbour to Larsen Point, South Georgia. Large otter trawl, 122–136 m.: 14 specimens, 45–155 mm.

St. 141. 29. xii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 17–27 m.: 3 specimens, 85–195 mm.

St. 144. 5. i. 27. Off mouth of Stromness Harbour, South Georgia. Net (4 mm. mesh) attached to back of trawl, 155–178 m.: 5 specimens, 53–90 mm.

St. 145. 7. i. 27. Stromness Harbour, South Georgia. Net (4 mm. mesh) attached to back of trawl, 26–35 m.: 14 specimens, 55–170 mm.

St. 148. 9. i. 27. Off Cape Saunders, South Georgia. Large otter trawl, with net (4 mm. mesh) attached, 132–148 m.: 17 specimens, 47–160 mm.

St. 149. 10. i. 27. Mouth of East Cumberland Bay, South Georgia. Large otter trawl, 200–234 m.: 3 specimens, 163–176 mm.

St. WS 62. 19. i. 27. Wilson Harbour, South Georgia. Small beam trawl, 26–83 m.: 6 specimens, 52–130 mm.

St. 156. 20. i. 27. 53° 51′ 00″ S, 36° 21′ 30″ W. Large dredge, 200–236 m.: 3 specimens, 62–128 mm.

St. 160. 7. ii. 27. Near Shag Rocks, 53° 43′ 40″ S, 40° 57′ 00″ W. Large dredge, 177 m.: 5 specimens, 73–153 mm.

St. 163. 17. ii. 27. Paul Harbour, Signy Island, South Orkneys. Small beam trawl, 18–27 m.: 1 specimen, 70 mm.

St. 173. 28. ii. 27. Port Foster, Deception Island, South Shetlands. Small beam trawl, 5–60 m.: 3 specimens, 73–142 mm.

St. 184. 15–16. iii. 27. Fournier Bay, Anvers Island, Palmer Archipelago. Large fish trap, 36 m.: 1 specimen, 100 mm.

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago. Large dredge—large rectangular net, 93–130 m.: 1 specimen, 152 mm.

St. 371. 14. iii. 30. 1 mile E of Montagu Island, South Sandwich Islands. Large otter trawl, with nets (4 mm. and 7 mm. mesh) attached, 99–161 m.: 4 specimens, 130–165 mm.

Depth of body 4 to $4\frac{3}{4}$ in the length, length of head $3\frac{1}{3}$ to $3\frac{3}{4}$. Snout as long as or rather shorter than eye, diameter of which is 3 to 4 in length of head; interorbital width 14 to 18. Jaws equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{3}$ of eye; cheeks and opercles more or less fully scaled, but lower part of cheek and edge of praeoperculum naked; occiput, interorbital region, snout and praeorbital naked; 10 to 13 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 55 to 62 in a longitudinal series from above base of pectoral to caudal; 35 to 42 in upper lateral line, which ends below posterior part of dorsal; lower lateral line without tubular scales. Dorsal IV–VI, 36–40. Anal 34–36. Pectoral with 22 or 23 rays, $\frac{2}{3}$ to $\frac{4}{5}$ length of head, generally rather shorter than pelvics, which reach vent or anal. Caudal rounded or subtruncate; caudal peduncle much deeper than long. Body with 2 or 3 series of large, partly confluent, irregular blackish spots and blotches, sometimes forming more or less definite oblique cross-bars; cheek usually with two oblique dark stripes; a round black spot on spinous dorsal; soft dorsal, caudal and anal with or without series of small dark spots, which, when present, may form stripes or bars; pectorals and pelvics pale, sometimes with narrow darker cross-bars.

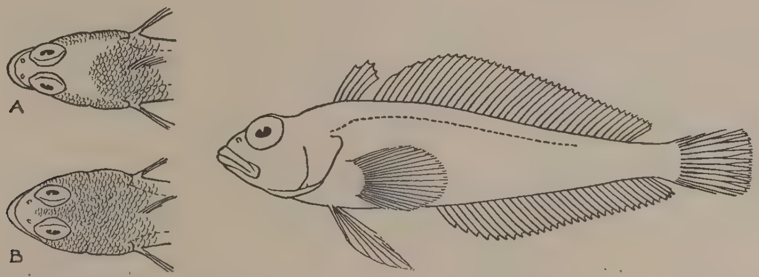

Fig. 9. *Notothenia nudifrons*. A, Dorsal view of head of *N. nudifrons*; B, The same of *N. mizops*. × $\frac{1}{2}$.

Hab. Graham Land and neighbouring islands; South Shetlands; South Orkneys; South Sandwich Islands; South Georgia.

This species was originally described from 7 specimens from Cape Seymour and south of Snow Hill, Graham Land, and from numerous specimens from South Georgia, at depths ranging from 12 to 250 metres. It is very common at South Georgia, at all depths from 10 to 250 metres. In life the fish appears to be reddish or reddish-brown on the back and sides and silvery white below; the spots are dark brown.

In general appearance this species is very similar to *N. mizops*, from Kerguelen, but may be readily distinguished by the naked occiput and interorbital region, the somewhat more numerous dorsal and anal rays, and the smaller scales.

I have examined 3 specimens in the Paris Museum, 62 to 118 mm. in total length, from the South Shetlands.

Notothenia acuta, Günther.

Notothenia acuta, Günther, 1880, *Shore Fish. 'Challenger'*, p. 17; Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. v, p. 171, pl. ix, fig. 3; Regan, 1913, *t.c.*, p. 272, pl. viii, fig. 3; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 62.

Depth of body $5\frac{3}{4}$ to 6 in the length, length of head 3 to $3\frac{2}{3}$. Snout a little shorter than eye, diameter of which is 3 to $3\frac{3}{4}$ in length of head; interorbital width about 16. Jaws equal anteriorly; maxillary extending to below anterior part of eye; cheeks, opercles, occiput and interorbital region scaly; snout naked in young, but partially scaled in larger specimens; praeorbital naked; 12 or 13 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 54 to 60 in a longitudinal series from above base of pectoral to caudal; 36 to 39 in upper lateral line, which ends below posterior part of dorsal or extends to base of caudal; 15 to 18 in lower lateral line. Dorsal VI–VII, 28–30. Anal 28–31. Pectoral with 19 or 20 rays, as long as or nearly as long as head, longer than pelvics, which reach the vent. Caudal rounded; caudal peduncle somewhat deeper than long. Body marbled with darker, and with 3 or 4 short, broad dark bars on upper parts of sides; dorsal rays sometimes with series of small spots; caudal fin faintly barred.

Hab. Kerguelen.

This description is based upon the type, about 62 mm. in total length, and upon 5 specimens, 48 to 95 mm. in total length, collected by the B.A.N.Z. Antarctic Research Expedition. The species occurs in fairly shallow water, the greatest depth at which it has been taken being 30 metres.

Notothenia angustifrons, Fischer.

Notothenia angustifrons, Fischer, 1885, *Jahrb. Hamburg. Wiss. Anst.*, II, p. 55; Regan, 1913, *t.c.*, p. 274, pl. viii, fig. 1.

Notothenia marionensis, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 27; 1906, *K. Svensk. Vet.-Akad. Handl.* XL (5), p. 93.

St. MS 6. 14. ii. 25. East Cumberland Bay, South Georgia. Small beam trawl, 24–30 m.: 1 specimen, 64 mm.

St. MS 10. 14. ii. 25. East Cumberland Bay, South Georgia. Small beam trawl, 26–18 m.: 12 specimens, 62–125 mm.

St. MS 12. 17. ii. 25. East Cumberland Bay, South Georgia. Small beam trawl, 25–60 m.: 2 specimens, 70, 120 mm.

St. MS 25. 13. iv. 25. East Cumberland Bay, South Georgia. Small beam trawl, 36 m.: 1 specimen, 70 mm.

St. MS 32. 1. v. 25. East Cumberland Bay, South Georgia. Small beam trawl, 40 m.: 2 specimens, 88, 182 mm.

St. MS 33. 1. v. 25. 1 cable E of Hobart Rock, East Cumberland Bay, South Georgia. Small beam trawl, 40 m.: 1 specimen, 86 mm.

St. MS 62. 24. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 31 m.: 2 specimens, 73, 77 mm.

St. MS 63. 24. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 23 m.: 3 specimens, 68–100 mm.

St. MS 65. 28. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 20–12 m.: 2 specimens, 120, 150 mm.

St. MS 66. 28. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 18 m.: 3 specimens, 72–88 mm.

St. MS 67. 28. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 38 m.: 2 specimens, 65, 85 mm.

St. MS 71. 9. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 110–60 m.: 1 specimen, 60 mm.

St. MS 74. 17. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 22–40 m.: 8 specimens, 55–205 mm.

St. —. 2. iv. 26. King Edward's Cove, South Georgia. Hand line, 5 m.: 1 specimen, 68 mm., found in mouth of *Notothenia rossii*.

St. WS 25. 17. xii. 26. Undine Harbour (North), South Georgia. Small beam trawl, 18–27 m.: 15 specimens, 35–155 mm.

St. 141. 29. xii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 17–27 m.: 14 specimens, 57–115 mm.

St. 145. 7. i. 27. Stromness Harbour, South Georgia. Small beam trawl, 26–35 m.: 3 specimens, 103–180 mm.

St. WS 62. 19. i. 27. Wilson Harbour, South Georgia. Small beam trawl, 26–83 m.: 2 specimens, 50, 52 mm.

St. 370. 10. iii. 30. 2 miles NE of Bristol Island, South Sandwich Islands. Large otter trawl, 80–18 m.: 42 specimens, 75–148 mm.

St. —. 25. iii. 30. Grytviken, South Georgia. Hand line, 5·5 to 10 metres: 1 specimen, 72 mm., from stomach of *Notothenia rossii.*

Depth of body 5 to $5\frac{3}{5}$ in the length, length of head $3\frac{1}{4}$ to $3\frac{2}{3}$. Snout as long as or rather longer than eye, diameter of which is $3\frac{3}{4}$ to nearly 5 in length of head; interorbital width 15 to 20. Jaws about equal anteriorly; maxillary extending to below anterior margin or anterior $\frac{1}{4}$ of eye; upper surface of head scaly to between nostrils; cheeks and opercles in great part scaly, but naked below and at edge of praeoperculum; snout and praeorbital naked; 10 to 12 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 46 to 52 in a longitudinal series from above base of pectoral to caudal; 26 to 34 in upper lateral line, which ends below middle or posterior part of dorsal; 15 to 26 in lower lateral line. Dorsal V–VIII, 28–30. Anal 29–31. Pectoral with 19 to 21 rays, $\frac{4}{5}$ to $\frac{5}{6}$ length of head, much longer than pelvics, which do not reach the vent in adult. Caudal rounded; caudal peduncle about as long as deep. Back with dark transverse bars, which break up into spots on the sides of the body; often a bar through the spinous dorsal, connecting the bases of the pectorals; dorsal, caudal and pectorals with series of small dark spots on the rays; anal and pelvics pale, sometimes with some darker spots; often a blackish spot on the upper part of the pectoral base.

Hab. South Sandwich Islands; South Georgia.

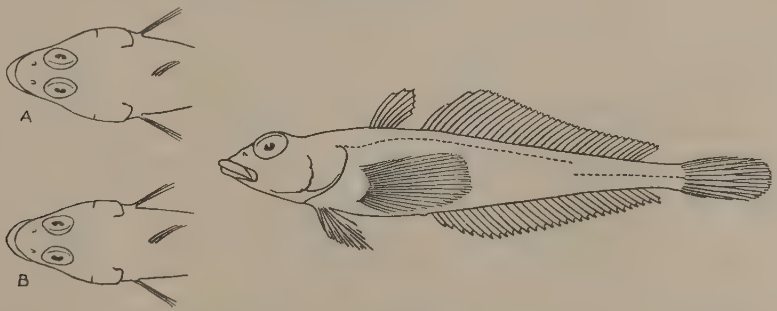

Fig. 10. *Notothenia angustifrons.* × $\frac{2}{3}$. A, Dorsal view of head of *N. angustifrons*; B, The same of *N. marionensis.* × 1.

This species, which is very common in shallow water round South Georgia, was originally described from 2 specimens, 82 and 88 mm. in length respectively, now preserved in the Zoological Museum at Hamburg (No. 3921). According to Lönnberg, this fish lives on the bottom among the algae, but is also often found "lying openly on the clayey bottom, inside the kelp". Unlike *N. gibberifrons*, it is said to be very active and difficult to catch.

Notothenia marionensis, Günther.

Notothenia marionensis, Günther, 1880, *Shore Fish. 'Challenger'*, p. 17; Regan, 1913, *t.c.*, p. 273, pl. viii, fig. 2.

Very closely related to *N. angustifrons*, but the interorbital width is 10 in the length of the head. Dorsal VII, 29. Anal 27. Pectoral $\frac{3}{4}$ length of head. Caudal peduncle a little deeper than long.

Hab. Marion Island, Kerguelen District.

This species is known only from the holotype, 82 mm. in total length, from 100 to 150 metres.

Notothenia cyanobrancha, Richardson.

Notothenia cyanobrancha, Richardson, 1844, *Zool. 'Erebus' and 'Terror'* (Fish.), p. 7, pl. iv; Studer, 1879, *Arch. Naturg.*, XLV (1), p. 131; Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. V, p. 171; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 62.
Notothenia purpuriceps, Richardson, 1844, *t.c.*, p. 7, pl. ii, figs. 3, 4; Günther, 1860, *Cat. Fish.*, II, p. 262; Gill, 1876, *Bull. U.S. Nat. Mus.*, III, p. 41; Studer, 1879, *t.c.*, p. 131.
Notothenia cyaneobrancha, Günther, 1860, *t.c.*, p. 261; Regan, 1913, *t.c.*, p. 275.
Notothenia coriiceps, Pappenheim, 1912, *t.c.*, p. 170, pl. ix, fig. 2.

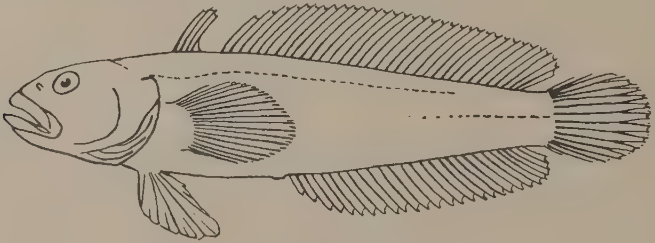

Fig. 11. *Notothenia cyanobrancha*. × $\frac{4}{5}$.

Depth of body 4 to 5 in the length, length of head 3 to 4. Snout as long as or a little longer than eye, diameter of which is 4 to $6\frac{1}{2}$ in length of head; interorbital width 5 to $6\frac{1}{2}$. Jaws equal anteriorly; maxillary extending to below middle or posterior part of eye; upper surface of head naked except for a few temporal and post-temporal scales, which may be absent in the young; cheek scaly behind and below eye, the lower $\frac{1}{2}$ (young) or $\frac{1}{4}$ (adult) naked; upper part of operculum scaly; 10 to 13 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 60 to 70 in a longitudinal series from above base of pectoral to caudal; 32 to 39 in upper lateral line which ends below posterior part of dorsal; lower lateral line, when developed, with 6 to 15 tubular scales. Dorsal IV–VI, 33–36. Anal 30–34. Pectoral with 20 or 21 rays, $\frac{3}{5}$ to $\frac{3}{4}$ length of head, as long as or longer than pelvics, which do not generally reach the vent in adult. Caudal rounded; caudal peduncle much deeper than long. More or less uniformly brownish or black, but sometimes with traces of darker markings; usually an oblique dark stripe from eye to angle of praeoperculum, and another below this; all the fins more or less dusky or blackish, at least in adult.

Hab. Kerguelen.

In addition to a number of specimens in the British Museum collection, 120 to 260 mm. in total length, including the type of the species (260 mm.) and the type of *N. purpuriceps* (128 mm.), the above description is based upon a large series of examples, 37 to 280 mm. in total length, collected by the B.A.N.Z. Antarctic Research Expedition. This is a shallow water and littoral species, which is abundant under stones between the tide-marks.

Notothenia coriiceps, Richardson.

Notothenia coriiceps, Richardson, 1844, *Zool. 'Erebus' and 'Terror'* (Fish.), p. 5, pl. iii, figs. 1, 2; Günther, 1860, *Cat. Fish.*, II, p. 261; Günther, 1879, *Phil. Trans. R. Soc.*, CLXVIII (extra vol.), p. 166; Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 3, p. 139; 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 24; Roule and Despax, 1911, *Bull. Mus. Paris*, 1911, No. 5, p. 278; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 3; Regan, 1913, *t.c.*, pp. 240, 276; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 22; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 63.

? *Pagothenia antarctica*, Nichols and LaMonte, 1936, *Amer. Mus. Novit.*, 839, p. 3, fig. 1.

St. —. 1922–23. Deception Island, South Shetlands, 10–30 m.: 1 specimen, 240 mm., collected by Mr A. G. Bennett.

St. 154. 18. i. 27. Jason Harbour to Larsen Point, South Georgia. Large otter trawl, 60–160 m.: 1 specimen, 530 mm.

St. —. 29. i. 27. Grytviken, South Georgia. Hand line, 3–4 m.: 1 specimen, 340 mm.

St. 163. 17. ii. 27. Paul Harbour, Signy Island, South Orkneys. Small beam trawl, 18–27 m.: 1 specimen, 420 mm.

St. 165. 18–19. ii. 27. Dove Strait, SE of Queen's Bay, Signy Island, South Orkneys. Large fish trap, 10 m.: 6 specimens, 330–370 mm.

St. 173. 28. ii. 27. Port Foster, Deception Island, South Shetlands. Small beam trawl, 5–60 m.: 1 specimen, 72 mm.

St. 174. 28. ii.–2. iii. 27. Deception Island, South Shetlands. Large fish trap, 5–10 m.: 5 specimens, 240–360 mm.

St. 179. 10. iii. 27. Melchior Island, Schollaert Channel, Palmer Archipelago. Small dredge, 4–10 m.: 1 specimen, 140 mm.

St. —. 13. iv. 27. Deception Island, South Shetlands. From trap on outer side of entrance: 2 specimens, 230, 235 mm.

St. 1092. 18. i. 33. Signy Island, South Shetlands. Found in bird's nest: 1 specimen, 72 mm.

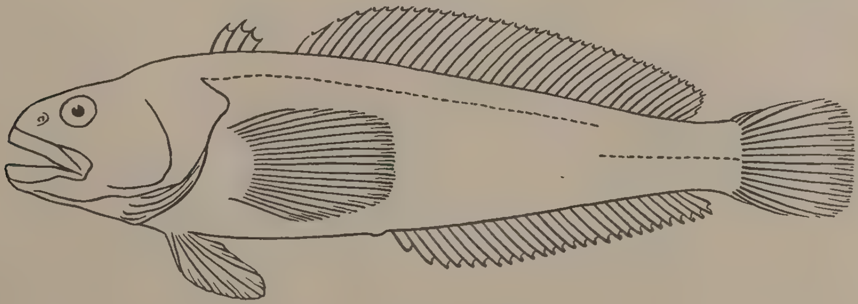

Fig. 12. *Notothenia coriiceps.* × $\frac{1}{3}$.

Depth of body $3\frac{2}{3}$ to $4\frac{1}{2}$ in the length, length of head $2\frac{4}{5}$ to $3\frac{2}{3}$. Snout longer than eye, diameter of which is 4 (young) to 7 in length of head; interorbital width $3\frac{4}{5}$ to 5 ($3\frac{2}{3}$ in large specimens). Jaws equal anteriorly; maxillary extending to below anterior part or middle (young) or posterior margin (adult) of eye; head naked, except for a few scales behind eye, on upper part of operculum, and on post-temporal region; 10 to 14 gill-rakers on lower part of anterior arch. Scales on body cycloid; 54 to 68 in a longitudinal series from above base of pectoral to caudal; 34 to 49 in upper lateral line, which ends below posterior part of dorsal; 6 to 17 in lower lateral line. Dorsal III–VII, 35–40. Anal 27–31. Pectoral with 17 or 18 rays, from less than $\frac{2}{3}$ (large specimens) to $\frac{5}{6}$ length of head, longer than pelvics, which do not or scarcely reach the vent. Caudal subtruncate or a little rounded in adult and half-grown specimens, emarginate in young; caudal peduncle nearly as long as deep. Coloration varying from dark greenish-black to a pale orange-yellow, with or without spots and markings; usually one or two oblique dark bars across cheek, sometimes broken up into spots; head sometimes with pale spots enclosed in dark rings; spots on body and dorsal fin sometimes large and tessellated, more often small and scattered, never very distinct and rarely uniting to form longitudinal stripes; dorsal and anal usually with pale edges, and sometimes with dark submarginal bands; pectorals and caudal more or less dusky; pelvics paler. Young dark on back, silvery on sides and beneath; a large black blotch on extremity of pectoral fin.

Hab. Graham Land and neighbouring islands; South Shetlands; South Orkneys; South Georgia; Kerguelen; Crozets; Heard Island; Adelie Land; Victoria Land.

This is the only species of *Notothenia* occurring on the coasts of the Victoria Quadrant of the Antarctic Continent. The type of the species from Kerguelen measures 255 mm. in total length.

The silvery young, which are probably pelagic in habit, are very similar to those of the closely related *N. rossii*, but may be readily distinguished from them by the black blotch on each pectoral fin. *Pagothenia antarctica* is known only from the unique holotype, 68 mm. in length to base of caudal, from Echo Canyon, 16 miles south-west of Little America (78° 45′ S, 165° 00′ W). Several of these fish were seen alive in a seal hole—an opening in a water filled crevasse, about 20 feet deep. Their colour in life was seen to be "an iridescent blue like the general color of the crevasse, some having patches of coral pink near the head". It is possible that these were young examples of *N. coriiceps*, and it may be noted that in the young specimen obtained from a bird's nest in the South Shetlands by the Discovery Committee the tubules of the upper lateral line are somewhat indistinct.

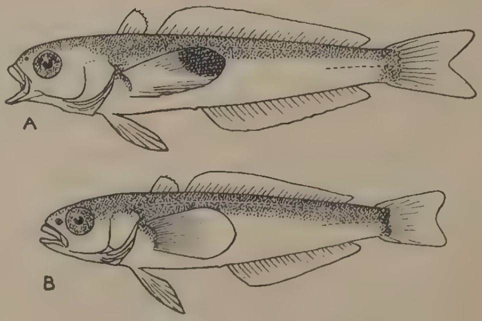

Fig. 13. Young of A, *Notothenia coriiceps*; B, *N. rossii*. × 1.

I have examined a poorly preserved specimen in the Paris Museum (No. 05—540), 198 mm. in length (without caudal). This bears a label "Orcades du Sud—Lahille".

Notothenia rossii, Richardson.

Notothenia rossii, Richardson, 1844, *Zool. 'Erebus' and 'Terror'* (Fish.), p. 9, pl. v, figs. 1, 2; Günther, 1860, *Cat. Fish.*, II, p. 263; Regan, 1913, *t.c.*, pp. 240, 276; 1916, *Ann. Mag. Nat. Hist.*, (8) XVIII, p. 378; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 64.

Macronotothen rossii, Gill, 1861, *Proc. Acad. Nat. Sci. Philad.*, 1861, p. 521.

Notothenia marmorata, Fischer, 1885, *Jahrb. Hamburg. Wiss. Anst.*, II, p. 53.

Notothenia macrocephala subsp. *marmorata*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 34; 1906, *K. Svensk. Vet.-Akad. Handl.*, XL (5), p. 94.

Notothenia coriiceps var. *macquariensis*, Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 64, pl. v, fig. 3, text-fig. 16.

St. MS 6. 14. ii. 25. East Cumberland Bay, South Georgia. Small beam trawl, 30 m.: 2 specimens, 115, 133 mm.

St. MS 10. 14. ii. 25. East Cumberland Bay, South Georgia. Small beam trawl, 26–18 m.: 5 specimens, 65–68 mm.

St. MS 25. 13. iv. 25. East Cumberland Bay, South Georgia. Small beam trawl, 36 m.: 6 specimens, 65–70 mm.

St. MS 63. 24. ii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 23 m.: 1 specimen, 68 mm.

St. MS 71. 9. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 110–60 m.: 2 specimens, 60, 69 mm.

St. MS 74. 17. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 22–40 m.: 1 specimen, 68 mm.

St. —. 2. iv. 26. King Edward's Cove, South Georgia. Hand-line, 5 m.: 1 specimen, 330 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 270–238 m.: 1 specimen, 420 mm.

St. —. 6. i. 27. Stromness Harbour, South Georgia. Hand-line, 9–10 m.: 2 specimens, 295, 355 mm.

St. 145. 7. i. 27. Stromness Harbour, South Georgia. Small beam trawl, 26–35 m.: 3 specimens, 103–250 mm.

St. —. 11. i. 27. Prince Olaf Harbour, South Georgia. Hand-line, 5 m.: 2 specimens, 195, 320 mm.

St. WS 65. 22. i. 27. Undine Harbour (North), South Georgia. Hand-line, 5 m.: 1 specimen, 290 mm.

St. 174. 28. ii.–2. iii. 27. Deception Island, South Shetlands. Large fish trap, 5–10 m.: 1 specimen, 245 mm.

St. WS 111. 25. v. 27. 53° 39′ 00″ S, 35° 34′ 00″ W. 70 cm. tow-net, horizontal, 0–5 m.: 1 specimen, 65 mm.

St. —. 27. iii. 28. South Georgia. 1 specimen, 56 mm., picked up on whaling plan.

St. —. 1–4. iv. 29. Government Jetty, Grytviken, South Georgia. 0–2 m.: 8 specimens, 62–70 mm.

St. WS 426. 15. iv. 29. 53° 34′ 00″ S, 40° 10′ 00″ W. Washed on board through scupper: 1 specimen, 60 mm.

St. —. 25. iii. 30. Grytviken, South Georgia. Hand-line, 6–10 m.: 22 specimens, 60–80 mm., taken from stomach of *Notothenia rossii*.

St. —. 30. iii. 30. Stromness Harbour, South Georgia. Hand-net, surface: 8 specimens, 65–73 mm.

St. WS 534. 22–23. i. 31. 54° $17\frac{1}{2}$′ S, 35° 39′ W. Hand-line (?), 5 m. (?): 1 specimen, 695 mm.
St. —. 28. iii. 31. Jetty, South Georgia. Hand-line: 4 specimens, 142–168 mm.

In addition to the above, the following specimens were obtained by S.S. 'Sitka':

7. i. 27. 30 miles NE of Cape Saunders, South Georgia. Hand-line, 1–2 m.: 2 specimens, 540, 590 mm., caught in a patch of "krill".

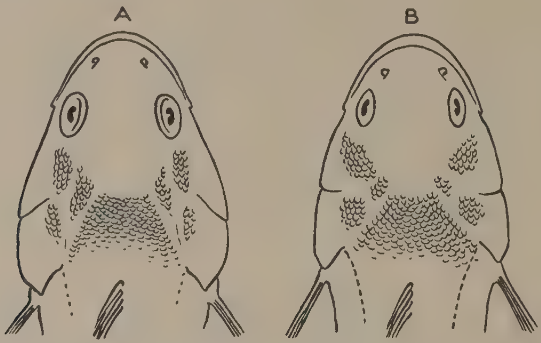

Fig. 14. Dorsal view of head of A, *Notothenia coriiceps*; B, *N. rossii*. × $\frac{1}{2}$.

Depth of body $3\frac{1}{2}$ to $4\frac{2}{3}$ in the length, length of head $3\frac{1}{4}$ to $3\frac{3}{4}$. Snout longer than eye (except in young), diameter of which is $3\frac{2}{3}$ (young) to $6\frac{1}{2}$ in length of head; interorbital width $2\frac{3}{4}$ (large specimens) to about $3\frac{3}{4}$. Jaws equal anteriorly or lower a little projecting; maxillary extending to below anterior part or middle of pupil, sometimes a little beyond; scales on upper part of cheek and operculum and on temporal region; upper surface of head papillose; 11 to 13 gill-rakers on lower part of anterior arch. Scales on body cycloid; 55 to 62 in a longitudinal series from above base of pectoral to caudal; 45 to 52 in upper lateral line, which ends below posterior part of dorsal; 10 to 18 in lower lateral line. Dorsal IV–VII, 32–36. Anal 26–30. Pectoral with 21 to 23 rays, $\frac{2}{3}$ to $\frac{7}{8}$ length of head, extending to level of vent or beyond (not as far in large specimens); pelvics much shorter. Caudal subtruncate or a little rounded in adult and half-grown specimens, emarginate in young; caudal peduncle as long as deep or a little deeper than long. In young the back is dark, the greater part of the sides and the lower parts silvery; the body generally becomes more or less marbled with age, the markings sometimes tending to form irregular longitudinal stripes; head in adult and half-grown specimens often with dark spots; dorsal fins with 2 or 3 series of dark spots, usually united to form irregular vermiculations or longitudinal bands; anal usually with a broad dusky band, and with a pale edge; other fins varying from pale yellow to more or less dusky, the caudal sometimes with a dark band.

Hab. South Shetlands; South Orkneys; South Georgia; Kerguelen; Macquarie Island.

The type of the species was a large stuffed specimen, 850 mm. in total length. The actual locality is unknown, but, as suggested by Regan, it was quite likely taken at Kerguelen. Richardson describes the first dorsal fin as "comparatively low...supported by bluntish spines, destitute of flexibility, or of filamentous tips". Such a spinous dorsal is often found in large Nototheniids, and has no taxonomic significance.

The silvery young of this species are said to have the back "lustrous blue" in life, and the fins quite transparent. They are found in shallow water, and are frequently taken at or near the surface. The adults and half-grown individuals present some variation in coloration, this being apparently dependent to some extent upon the depth of water in which they are living. According to Lönnberg, "the large specimens caught in the open sea, lived near the surface so that they easily could be seen swimming hither and thither". One large specimen was captured by the 'Discovery', however, at a depth of from 238 to 270 metres.

Notothenia macrocephala, Günther.

For a full synonymy and description of this species see Norman, 1937, *Discovery Rep.*, XVI, p. 88, fig. 43.

Hab. Patagonia; Falkland Islands; Straits of Magellan; coast of Chile; Kerguelen; New Zealand; Auckland Island; Campbell Island; Macquarie Island.

Peters (1876, *Monatsber. Akad. Berlin*, p. 837) described this species from Kerguelen as *Notothenia antarctica*, and there are two very small specimens from the same locality taken by the 'Challenger', which have been referred to this species by Regan (see Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 69, footnote). I have given a full description and figure in my previous report.

Notothenia colbecki, Boulenger.

Notothenia colbecki, Boulenger, 1902, *Rep. Coll. Nat. Hist. 'Southern Cross'*, p. 185, pl. XVI; Waite, 1909, *Subantarctic Isl. N. Zealand*, Pisces, p. 594; Regan, 1913, *t.c.*, p. 278; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 70.

Hab. Auckland Island; Campbell Island; Macquarie Island.

The types of this species, up to 385 mm. in total length, are from Campbell Island. Waite has recorded a single large individual, 685 mm in total length, caught with the hook amongst the kelp at Macquarie Island.

Genus **TREMATOMUS**

Trematomus, Boulenger, 1902, *Rep. Coll. Nat. Hist. 'Southern Cross'*, p. 177; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 258. Type *Trematomus newnesi*, Boulenger.

Differs from *Notothenia* only in that the hypercoracoid encloses its foramen. Vertebrae 52 to 56 (17–21+32–35).

Coasts of the Antarctic Continent; South Shetlands; South Orkneys; South Georgia.

Key to the Species

I. Upper surface of head naked.
  A. Cheeks and opercles fully scaled.
    1. Interorbital width $3\frac{1}{3}$ to 5 in head; dorsal V–VIII, 32–38; anal 32–36 1. *newnesi.*
    2. Interorbital width 8 or 9 in head; dorsal IV, 37; anal 32–35 ... ... 2. *nicolai.*

B. Cheeks and opercles scaly above, naked below.
  1. Dorsal V–VI, 34–37; anal 31–33 ... ... 3. *borchgrevinki.*
  2. Dorsal IV–V, 30–33; anal 29–30 ... ... 4. *brachysoma.*

II. Occiput scaly; cheeks and opercles fully scaled.
A. Interorbital region naked or incompletely scaled.
  1. Eye 3 to 4½ in head, which is 3¼ to 4 in length (without caudal); interorbital region naked or with a median series of scales; 60 to 75 scales in a longitudinal series 5. *bernacchii.*
  2. Eye (3⅔ young) 4⅖ to 4⅗ in head, which is 3¼ to 3⅓ in length (without caudal); interorbital region with 2 or 3 series of scales in the middle (naked in young); 55 to 59 scales in a longitudinal series ... ... 6. *vicarius.*

B. Interorbital region fully scaled.
  1. Snout and lower jaw naked; praeorbital naked (except in *T. scotti*).
    a. Upper lateral line with at least 30 tubular scales, extending well beyond extremity of pectoral; praeorbital naked.
      α. 60 to 75 scales in a longitudinal series; 36 to 46 in upper lateral line; pectoral with 27 to 29 rays.
        * Dorsal V–VII, 36–41; anal 33–36 ... ... 7. *hansoni.*
        ** Dorsal V–VI, 31–33; anal 31–33 ... ... 8. *loennbergii.*
      β. 52 to 56 scales in a longitudinal series; 30 to 39 in upper lateral line; pectoral with 24 or 25 rays; dorsal IV–VI, 32–36.
        * Dorsal spines flexible; eye 3¼ to 3½ in head ... ... 9. *pennellii.*
        ** Dorsal spines pungent; eye 2¾ to 3¼ in head ... ... 10. *centronotus.*
    b. Upper lateral line with 10 to 23 tubular scales, rarely extending beyond extremity of pectoral fin; praeorbital usually partly or entirely scaled 11. *scotti.*
  2. Snout, lower jaw, and praeorbital scaled.
    a. Vent much nearer to tip of snout than to end of anal fin; 26 to 38 tubular scales in lower lateral line; dorsal VI–VII, 31–33; anal 34–36 ... 12. *lepidorhinus.*
    b. Vent nearly equidistant from tip of snout and end of anal fin; 10 to 22 tubular scales in lower lateral line; dorsal VI–VII, 34–37; anal 32–34 13. *eulepidotus.*

Trematomus newnesi, Boulenger.

Trematomus newnesi, Boulenger, 1902, *Rep. Coll. Nat. Hist. 'Southern Cross'*, p. 177, pl. xi; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, pp. 239, 259; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 18; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 69.

Notothenia cyaneobrancha, Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 3, p. 139; 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 26.

Notothenia microlepidota, Vaillant, 1906, *t.c.*, p. 139; 1906, *t.c.*, p. 35.

Notothenia hodgsoni, Boulenger, 1907, *Nat. Antarct. Exped. Nat. Hist.*, II, Fish., p. 2, pl. i, fig. 2.

St. —. 8. ii. 24. Deception Island, South Shetlands. 3 specimens, 98–110 mm., from stomach of Shag; collected by Mr J. E. Hamilton.

St. 163. 17. ii. 27. Paul Harbour, Signy Island, South Orkneys. Small beam trawl, 18–27 m.: 1 specimen, 75 mm.

St. 173. 28. ii. 27. Port Foster, Deception Island, South Shetlands. Small beam trawl, 5–60 m.: 7 specimens, 66–80 mm.

St. 179. 10. iii. 27. Melchior Island, Schollaert Channel, Palmer Archipelago. Small dredge, 4–10 m.: 5 specimens, 30–70 mm.

St. 184. 15–16. iii. 27. Fournier Bay, Anvers Island, Palmer Archipelago. Large fish trap, 36 m.: 1 specimen, 87 mm.

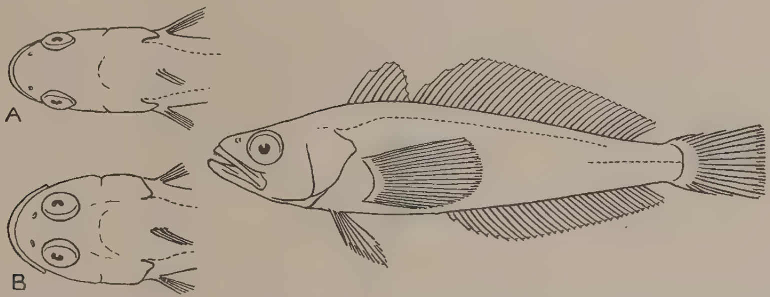

Fig. 15. *Trematomus newnesi.* A, Dorsal view of head of *T. newnesi*; B, The same of *T. nicolai.* × ½.

Depth of body 4 to 5½ in the length, length of head 3¼ to 4¼. Snout rather shorter than eye, diameter of which is 3 to 4⅓ in length of head; interorbital width 3⅓ to 5. Jaws equal anteriorly or lower a little projecting; maxillary extending to below anterior part or middle of eye (young) or beyond (adult); upper surface of head naked, cheeks and opercles scaly; 15 to 20 gill-rakers on lower part of anterior arch. Scales on body rather feebly ctenoid; 68 to 86 in a longitudinal series from above base of pectoral to caudal; 40 to 52 in upper lateral line, which ends below posterior rays of dorsal; 3 to 19 in lower lateral line. Dorsal V–VIII, 32–38. Anal 32–36. Pectoral with 24 or 25 rays, ¾ length of head or more, longer than pelvics, which reach the vent in young but not in adult. Caudal truncate (adult) or a little emarginate (young); caudal peduncle about as long as deep. Brownish, usually spotted or marbled, or with irregular cross-bars; spinous dorsal blackish; other fins dusky, often with small dark spots.

Hab. Graham Land; South Shetlands; South Orkneys; Mac-Robertson Land; Queen Mary Land; Adelie Land; South Victoria Land.

The numerous types of this species, ranging in length from 90 to 190 mm., are from Duke of York Island, near Cape Adare, 6 to 10 metres, and from Cape Adare, 8 to 16 metres; those of *N. hodgsoni*, measuring up to 160 mm. in total length, are from the 'Discovery' Winter Quarters, Ross Island. This species seems to occur mainly in shallow water.

I have examined 7 specimens in the Paris Museum (No. 06—119), 70 to 120 mm. in total length, identified by Vaillant as *Notothenia cyaneobrancha.* Specimens identified by the same author as *N. microlepidota* cannot now be found. The British Graham Land Expedition, 1934–7, obtained 4 specimens (60 to 92 mm.), from approximately 65° S, 65° W, at a depth of about 12 metres.

Trematomus nicolai (Boulenger).

Notothenia nicolai, Boulenger, 1902, *Rep. Coll. Nat. Hist. 'Southern Cross'*, p. 184, pl. xv.
Trematomus nicolai, Regan, 1913, *t.c.*, p. 260; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 18.

Depth of body nearly 4 in the length, length of head $3\frac{1}{3}$ to $3\frac{1}{2}$. Snout shorter than eye, diameter of which is $2\frac{4}{5}$ (young) to $3\frac{1}{3}$ in length of head; interorbital width 8 to 9. Lower jaw a little projecting; maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{3}$ of eye; upper surface of head naked; cheeks and opercles scaly; 11 or 12 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 58 to 62 in a longitudinal series from above base of pectoral to caudal; 39 to 43 in upper lateral line, which ends below posterior rays of dorsal, 8 to 18 in lower lateral line. Dorsal IV–V, 37. Anal 32–35. Pectoral with 28 to 30 rays, $\frac{3}{4}$ to $\frac{4}{5}$ length of head, somewhat longer than pelvics, which reach vent or origin of anal. Caudal rounded; caudal peduncle nearly as long as deep. Brownish, with indistinct dark cross-bars, and sometimes with some scattered small dark spots; fins dusky.

Hab. Queen Mary Land; South Victoria Land.

The types of the species, 3 specimens 150 to 250 mm. in total length, are from Cape Adare, 10 to 16 metres, and from Duke of York Island, near Cape Adare, 8 metres. The two examples recorded by Waite from Queen Mary Land, each 115 mm. in total length, were from a depth of 643 metres.

Trematomus borchgrevinki, Boulenger.

Trematomus borchgrevinki, Boulenger, 1902, *Rep. Coll. Nat. Hist. 'Southern Cross'*, p. 179, pl. xii; 1907, *Nat. Antarct. Exped. Nat. Hist.*, II, Fish., p. 1; Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. v, p. 171; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 6; Regan, 1913, *t.c.*, pp. 239, 260.

Trematomus borchgrevinski, Roule and Despax, 1911, *Bull. Mus. Paris*, 1911, No. 5, p. 279.

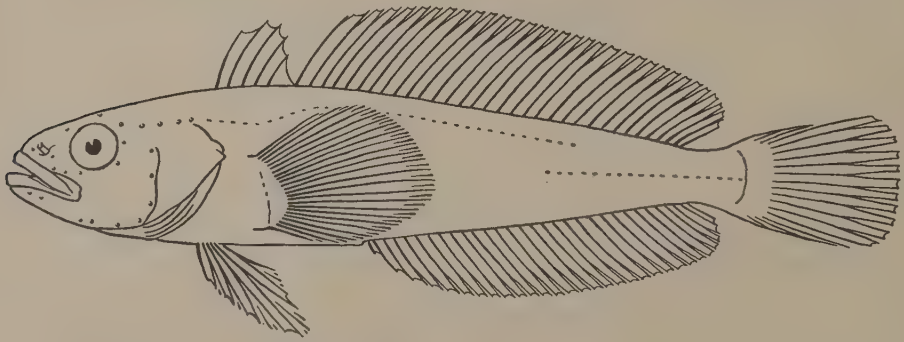

Fig. 16. *Trematomus borchgrevinki*. × $\frac{1}{2}$.

Depth of body 4 to 5 in the length, length of head $3\frac{1}{2}$ to $4\frac{1}{4}$. Snout as long as or a little longer than eye, diameter of which is 4 to 5 in length of head; interorbital width 3 to 4. Jaws equal anteriorly or lower a little projecting; maxillary extending to below anterior $\frac{1}{3}$ of eye; upper surface of head naked; upper parts of cheeks and opercles scaly; 16 to 19 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 78 to 96 in a longitudinal series from above base of pectoral to caudal; lateral lines without or with only a few tubular scales. Dorsal V–VI, 34–37. Anal 31–33. Pectoral with

23 rays, $\frac{3}{4}$ to $\frac{7}{8}$ length of head, longer than pelvics, which rarely reach the vent. Caudal rounded or subtruncate; caudal peduncle as long as deep or deeper than long. Yellowish, with dark spots or irregular cross-bars; dorsal and caudal sometimes with series of spots.

Hab. Graham Land; South Orkneys; Wilhelm Land; South Victoria Land.

The types of the species, 120 to 275 mm. in total length, are from Cape Adare and from Duke of York Island, near Cape Adare. The species is known only from shallow water.

The British Graham Land Expedition obtained 2 specimens (108 and 130 mm.) at the surface, and 7 specimens (*c.* 80 to 135 mm.) from stomachs of *Pygoscelis*, from approximately 65° S, 65° W.

Trematomus brachysoma, Pappenheim.

Trematomus brachysoma, Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. V, p. 172; Regan, 1913, *t.c.*, p. 261; Regan, 1914, *Rep. Brit. Antarct.* (*'Terra Nova'*) *Exped.* 1910, Zool. I (1), pp. 2, 3, pl. ii, fig. 3.

Depth of body 4$\frac{1}{10}$ to 4$\frac{7}{8}$ in the length, length of head 3 to 3$\frac{2}{5}$. Snout about as long as eye, diameter of which is 3$\frac{2}{5}$ to a little more than 4 in length of head; interorbital width 4 to 5$\frac{1}{2}$. Jaws equal anteriorly; maxillary extending to below anterior part or middle of eye; upper surface of head naked; upper parts of cheeks and opercles scaly; 15 to 19 gill-rakers on lower part of anterior arch. Scales on body cycloid or feebly ctenoid; 55 to 60 in a longitudinal series from above base of pectoral to base of caudal; lateral lines without or with only a few tubular scales. Dorsal IV–V, 30–33. Anal 26–30. Pectoral with 23 or 24 rays, about $\frac{7}{8}$ length of head, much longer than pelvics, which reach the vent or not quite as far. Caudal rounded; caudal peduncle a little deeper than long. Yellowish brown, with a series of 6 dark spots on back below the dorsal fins, and 5 below them at level of base of pectoral; a round black spot on spinous dorsal; soft dorsal, caudal and sometimes the anal with series of small round dark spots forming irregular bars.

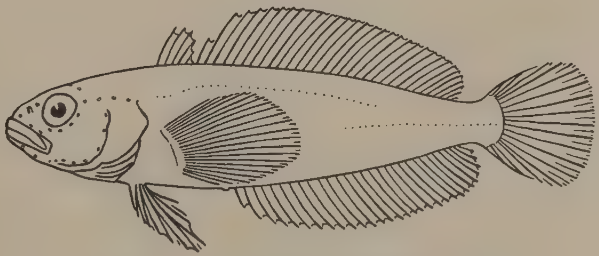

Fig. 17. *Trematomus brachysoma.* × $\frac{1}{2}$.

Hab. Wilhelm Land; South Victoria Land.

The above description is based upon a co-type of the species, 126 mm. in total length, taken at the surface at the Winter Quarters of the 'Gauss'; and another example, 170 mm. in total length, stranded on an ice floe in 67° 24′ S, 177° 34′ W, taken by the 'Terra Nova'.

This species is closely related to *T. borchgrevinki*, but may be readily distinguished by the larger scales and the lower number of dorsal and anal rays.

Trematomus bernacchii, Boulenger.

Trematomus bernacchii, Boulenger, 1902, *Rep. Coll. Nat. Hist. 'Southern Cross'*, p. 181, pl. xiv; 1907, *Nat. Antarct. Exped. Nat. Hist.*, II, Fish., p. 1; Waite, 1911, *Brit. Antarct. Exped.*, 1907–1909, II, Biol., II, p. 12; Roule and Despax, 1911, *Bull. Mus. Paris*, 1911, No. 5, p. 279; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 7; Regan, 1913, *t.c.*, pp. 239, 262, fig. 6 A; Regan, 1914, *t.c.*, p. 3, pl. i, fig. 1; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 19.

Notothenia marionensis, Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 3, p. 139.

Notothenia elegans, Vaillant, 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 28.

Notothenia longipes (part), Boulenger, 1907, *t.c.*, p. 1.

Notothenia nicolai, Boulenger, 1907, *t.c.*, p. 2.

Notothenia nicolai, Roule and Despax, 1911, *t.c.*, p. 278; Roule, Angel and Despax, 1913, *t.c.*, p. 5.

St. 178. 9–10. iii. 27. Melchior Harbour, Schollaert Channel, Palmer Archipelago. Large fish trap, 17 m.: 1 specimen, 137 mm.

St. 189. 23–24. iii. 27. Port Lockroy, Wiencke Island, Palmer Archipelago. Large fish trap, 70 m.: 1 specimen, 147 mm.

Depth of body 3 to 4½ in the length, length of head 3¼ to 4. Snout as long as or rather shorter than eye, diameter of which is 3 to 4½ in length of head; interorbital width 5 to 9. Jaws equal anteriorly or lower a little projecting; maxillary extending to below anterior part or middle of eye; cheeks, opercles and occiput scaly; interorbital region naked or with a median series of scales; 13 to 15 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 60 to 75 in a longitudinal series from above base of pectoral fin to caudal; 30 to 42 in upper lateral line; lower lateral line usually without tubular scales. Dorsal IV–VI, 34–38. Anal 31–35. Pectoral with 23 to 25 rays, about ⅔ length of head, about as long as pelvics, which just reach anal in young but not in adult. Caudal rounded; caudal peduncle deeper than long. Brownish; large dark spots in 2 or 3 alternating series; upper part of spinous dorsal blackish; other fins often more or less dusky.

Hab. Graham Land; South Shetlands; South Orkneys; Mac-Robertson Land; Queen Mary Land; Adelie Land; South Victoria Land.

The types of the species, 120 to 250 mm. in total length, are from Cape Adare, 10 to 16 metres, and from Duke of York Island, near Cape Adare, 6 to 8 metres. Like the previous species, *T. bernacchii* usually occurs in rather shallow water, but the 'Aurora' obtained one example from Commonwealth Bay at a depth of 635 to 732 metres.

Three young specimens (45–47 mm.), from Deception Island, South Shetlands, collected by Mr A. G. Bennett in February 1918, appear to be referable to this species. I have examined the specimen in the Paris Museum (No. 06—126), 118 mm. in total length, identified by Vaillant as *Notothenia elegans*. The fish (No. ?) from Peterman

Island, at a depth of 1 metre, identified by Roule, Angel and Despax as *N. nicolai*, is 135 mm. in total length, and is in very poor condition. Scales are apparently present on the occiput, but not on the interorbital region, and I have little doubt that the specimen should be referred to this species. The British Graham Land Expedition obtained 9 specimens (133 to 230 mm.) from fish traps at approximately 65° S, 65° W, and one specimen (95 mm.) thrown ashore at Barry Island (68° S, 67° W).

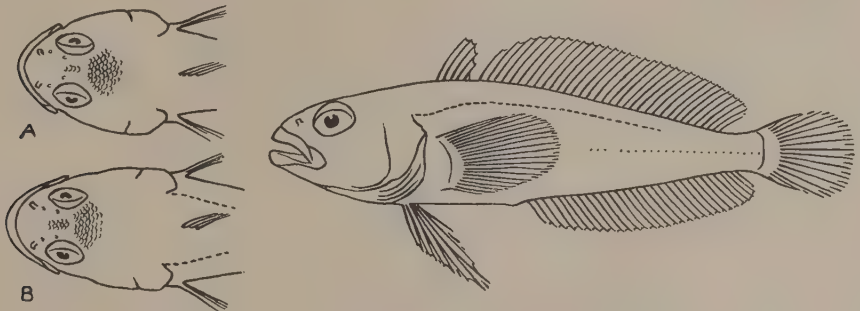

Fig. 18. *Trematomus bernacchii*. A, Dorsal view of head of *T. bernacchii*; B, The same of *T. vicarius*. × ½.

Trematomus vicarius, Lönnberg.

Trematomus bernacchii subsp. *vicarius*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 26.

? *Notothenia dubia*, Lönnberg, 1905, *t.c.*, p. 28, pl. iii, fig. 9.

Trematomus vicarius, Regan, 1913, *t.c.*, p. 261, fig. 6 B.

Trematomus dubius, Regan, 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.*, 1910, Zool. 1 (1), p. 2.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 1 specimen, 180 mm.

Very similar to the preceding species, but length of head 3¼ to 3⅓ in that of fish (without caudal); diameter of eye (3⅔ young) 4⅖ to 4⅗ in length of head; interorbital width about 5 (6½ in young); interorbital region naked in young, but with 2 or 3 series of scales in the middle in adult and half-grown specimens. 55 to 59 scales in a longitudinal series, (30) 34 to 37 in upper lateral line. Dorsal V, 33–38. Anal 31–32. Pectoral ¾ to ⅘ length of head, about as long as pelvics, which just reach the anal.

Hab. South Georgia.

The type of *T. vicarius*, 240 mm. in length without the caudal fin, was taken outside Boiler Harbour, Cumberland Bay, South Georgia, at a depth of 30 metres. This species is very close to *T. bernacchii*, and may eventually prove to be no more than a local race.

Notothenia dubia was based upon 3 specimens, 39 to 45 mm. in length without the caudal fin, from the same locality, at a depth of 20 metres; one of these types was examined by Regan. There can, I think, be little doubt that this form is the young of *T. vicarius*. Regan has compared the example of 50 mm. with one of *T. bernacchii* of the same size, and finds that it has a smaller eye, broader interorbital region, and larger scales—exactly the characters used to separate *T. bernacchii* from *T. vicarius*.

The British Graham Land Expedition obtained one specimen (69 mm.) from Stromness Bay, South Georgia, where it was found to be food of the Tern.

Trematomus hansoni, Boulenger.

Trematomus hansoni, Boulenger, 1902, *Rep. Coll. Nat. Hist. 'Southern Cross'*, p. 180, pl. xiii; Roule and Despax, 1911, *Bull. Mus. Paris*, 1911, No. 5, p. 279; Waite, 1911, *Brit. Antarct. Exped.*, 1907–1909, II, Biol., II, p. 13; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 6; Regan, 1913, *t.c.*, pp. 239, 262; 1914, *Rep. Brit. Antarct.* (*'Terra Nova'*) *Exped.*, 1910, Zool. I (1), p. 3, pl. i, fig. 2.

Trematomus hansoni subsp. *georgianus*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 25, pl. v, fig. 17.

Notothenia sima, Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 3, p. 139; 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 23.

Notothenia lepidorhinus (part), Pappenheim, 1912, *Deutsche Südpol.-Exped.* XIII, Zool. V, p. 169.

St. MS 68. 2. iii. 26. East Cumberland Bay, South Georgia. Large rectangular net, 220–247 m.: 4 specimens, 190–285 mm.

St. 30. 16. iii. 26. West Cumberland Bay, South Georgia. Large dredge, 251 m.: 1 specimen, 170 mm.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 22 specimens, 140–320 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 238–270 m.: 2 specimens, 180, 205 mm.

St. 123. 15. xii. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 230–250 m.: 2 specimens, 240, 295 mm.

St. WS 32. 21. xii. 26. Mouth of Drygalski Fjord, South Georgia. Small beam trawl, 91–225 m.: 1 specimen, 172 mm.

St. 148. 9. i. 27. Off Cape Saunders, South Georgia. Large otter trawl, 132–148 m.: 1 specimen, 250 mm.

St. WS 62. 19. i. 27. Wilson Harbour, South Georgia. Small beam trawl, 26–83 m.: 1 specimen, 79 mm.

St. 160. 7. ii. 27. Near Shag Rocks, South Georgia. Large dredge, 177 m.: 1 specimen, 138 mm.

St. 167. 20. ii. 27. Off Signy Island, South Orkneys. Net (7 mm. mesh) attached to back of trawl, 244–344 m.: 2 specimens, 142, 150 mm.

St. 178. 9–10. iii. 27. Melchior Harbour, Schollaert Channel, Palmer Archipelago. Large fish trap, 17 m.: 1 specimen, 135 mm.

The following young specimens may also belong here:

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: 9 specimens, 41–44 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 238–270 m.: 6 specimens, 40–43 mm.

Depth of body $3\frac{1}{2}$ to $4\frac{2}{3}$ in the length, length of head $3\frac{1}{5}$ to 4. Snout as long as or a little longer than eye, diameter of which is $3\frac{2}{3}$ to 5 in length of head; interorbital width 5 to $6\frac{1}{2}$. Jaws about equal anteriorly; maxillary extending to below anterior part or middle of eye; occiput, interorbital region, cheeks and opercles scaly; 13 to 16 gill-rakers on lower part of anterior arch. Scales on body cycloid or ctenoid; 60 to 68 in a longitudinal series from above base of pectoral to caudal; 38 to 46 in upper lateral line; lower lateral line usually without tubular scales. Dorsal V–VII, 36–41. Anal

33–36. Pectoral with 27 to 29 rays, $\frac{3}{4}$ to $\frac{7}{8}$ length of head, longer than pelvics, which just reach the vent in young but not in adult. Caudal subtruncate; caudal peduncle about as long as deep. Brownish, with large dark spots or cross-bars; head often spotted; spinous dorsal blackish; other fins usually barred with series of dark spots.

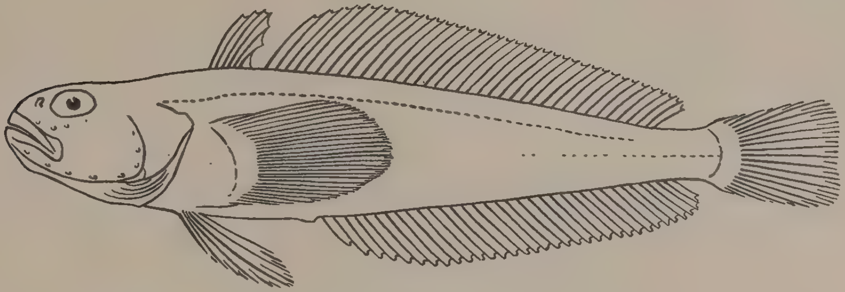

Fig. 19. *Trematomus hansoni.* × $\frac{1}{2}$.

Hab. Graham Land and neighbouring islands; South Shetlands; South Orkneys; South Georgia; Coats Land; Wilhelm Land; Queen Mary Land; South Victoria Land.

The types of the species, 160 to 280 mm. in total length, are from Cape Adare, 8 to 16 metres, and from Duke of York Island, near Cape Adare, 6 to 8 metres. Regan has shown that Lönnberg's supposed subspecies from South Georgia is fully identical with the typical form. The specimen of 137 mm. from Booth Wandel Island (Paris Museum, No. 06—99), recorded by Vaillant as *Notothenia sima*, appears to belong here.

Trematomus loennbergii, Regan.

Notothenia nicolai (*non* Boulenger), Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 45.

Notothenia longipes (part), Boulenger, 1907, *Nat. Antarct. Exped. Nat. Hist.*, II, Fish., p. 1.

Trematomus loennbergii, Regan, 1913, *t.c.*, p. 263, pl. viii, fig. 4; 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.*, 1910, Zool. I (1), p. 3; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 20.

Depth of body 4 to 5 in the length, length of head 3 to $3\frac{3}{4}$. Snout rather shorter than eye, diameter of which is 3 to $3\frac{1}{2}$ in length of head; interorbital width 6 to 10. Jaws about equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{3}$ of eye; upper surface of head to nostrils, cheeks and opercles scaly; 10 to 13 gill-rakers on lower part of anterior arch. Scales on body more or less ctenoid; 60 to 75 in a longitudinal series from above base of pectoral to caudal; 34 to 46 in upper lateral line; lower lateral line, when developed, with 10 to 15 tubular scales. Dorsal V–VII, 31–35. Anal 31–35. Pectoral with 28 or 29 rays, nearly as long as head, longer than pelvics, which reach vent or origin of anal. Caudal rounded or subtruncate; caudal peduncle as long as or longer than deep. Brownish, with irregular darker cross-bars; inside of mouth and branchial cavities blackish; sometimes an indistinct dark blotch on spinous dorsal.

Hab. Graham Land; Queen Mary Land; Adelie Land; South Victoria Land.

This species was originally described from 3 specimens: 1 (132 mm. in total length) from south-west of the Balleny Islands, 476 metres; 1 (65 mm.) from Tent Island, near Ross Island; and 1 (about 65 mm.) from Seymour Island, collected in tide-pools. It is closely related to *T. hansoni*, but may be distinguished from that species by the smaller number of dorsal and anal rays, and by the presence (usually) of tubular scales in the lower lateral line. Further, Waite has pointed out that in life this species is reddish in colour, whereas *T. hansoni* is greenish or greyish. As a general rule, *T. loennbergii* appears to live in deeper water than *T. hansoni*.

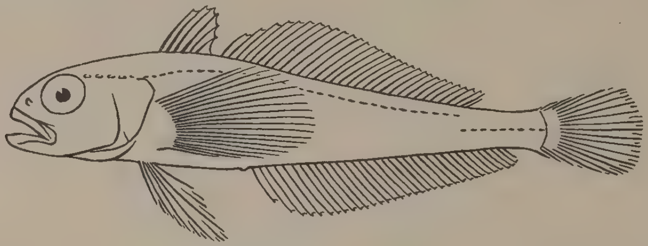

Fig. 20. *Trematomus loennbergii.* × ½.

Trematomus pennellii, Regan.

Trematomus pennellii, Regan, 1914, *Ann. Mag. Nat. Hist.*, (8) XIII, p. 12; 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.*, 1910, Zool. I (1), p. 4, pl. iii, fig. 2; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 20.

Depth of body 4½ to 5 in the length, length of head 3⅓ to 3½. Snout as long as or rather shorter than eye, diameter of which is 3¼ to 3½ in length of head; interorbital width 8 to 10. Jaws equal anteriorly; maxillary extending to below anterior ¼ of eye; occiput, interorbital region, cheeks and opercles scaly; 13 to 16 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 52 to 56 in a longitudinal series from above base of pectoral to caudal; 32 to 36 in upper lateral line, which ends below posterior part of dorsal; lower lateral line without tubular scales. Dorsal IV–VI, 32–35; spines flexible. Anal 29–31. Pectoral with 24 or 25 rays, ¾ or ⅘ length of head, as long as or longer than pelvics, which reach origin of anal. Caudal subtruncate; caudal peduncle as long as deep. Olivaceous, with two or three series of large dark spots, which may unite to form irregular cross-bars; distal part of spinous dorsal blackish.

Hab. Queen Mary Land; South Victoria Land.

The types of the species, 5 specimens 100 to 140 mm. in total length, are from off Cape Adare, 82 to 94 metres. Waite has recorded 10 specimens, up to 180 mm. in length, from off Drygalski Island, 112 metres.

Trematomus centronotus, Regan.

Trematomus centronotus, Regan, 1914, *Ann. Mag. Nat. Hist.*, (8) XIII, p. 12; 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.*, 1910, Zool. I (1), p. 4, pl. iii, fig. 1; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 21; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 70.

Depth of body 4 to 5 in the length, length of head $3\frac{1}{4}$ to $3\frac{3}{5}$. Snout shorter than eye, diameter of which is $2\frac{3}{4}$ (young) to $3\frac{1}{4}$ in length of head; interorbital width 10 to 12. Jaws equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{3}$ of eye; occiput, interorbital region, cheeks and opercles scaly; 13 to 15 gill-rakers on lower part of anterior arch. Scales on body cycloid or rather feebly ctenoid; 52 to 56 in a longitudinal series from above base of pectoral to caudal; 30 to 39 in upper lateral line, which ends below posterior part of dorsal; lower lateral line without tubular scales. Dorsal V–VI, 32–36; spines stiff, pungent. Anal 29–32. Pectoral with 24 or 25 rays, $\frac{3}{5}$ to $\frac{4}{5}$ length of head, a little shorter than pelvics, which extend to origin of anal. Caudal apparently subtruncate; caudal peduncle about as long as deep. Brownish, with large dark spots, uniting to form irregular cross-bars; a black spot on distal part of spinous dorsal.

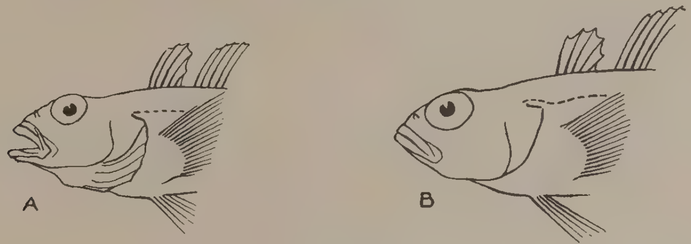

Fig. 21. Lateral view of head of A, *Trematomus pennellii*; B, *T. centronotus*. × ½.

Hab. Mac-Robertson Land; Queen Mary Land; Adelie Land; South Victoria Land.

The types of this species, 2 specimens 175 and 210 mm. in total length, are from McMurdo Sound, 187 to 375 metres. It is very like *T. pennellii*, and, apart from the stiff and pungent dorsal spines, it scarcely differs from that species except in the larger eye. *T. centronotus* appears to be found in rather deeper water than *T. pennellii*.

Trematomus scotti (Boulenger).

Notothenia scotti, Boulenger, 1907, *Nat. Antarct. Exped. Nat. Hist.*, II, Fish., p. 2, pl. i, fig. 1; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 5; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 271.

Trematomus scotti, Regan, 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.*, 1910, Zool. I (1), p. 4, pl. iv, fig. 2; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 21; Norman, 1937, *t.c.*, p. 70.

St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago. Nets (4 mm. and 7 mm. mesh) attached to back of trawl, 160–235 m.: 6 specimens, 95–145 mm.

St. 187. 18. iii. 27. Neumayr Channel, Palmer Archipelago. Large dredge, 259 m.: 1 specimen, 145 mm.

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago. Large dredge, 315 m.: 1 specimen, 68 mm.

St. 599. 17. i. 31. 67° 08′ S, 69° 06½′ W. Large dredge, 203 m.: 3 specimens, 70–125 mm.

St. 1652. 23. i. 26. 75° 56·2′ S, 178° 35·5′ E. Rectangular dredge, with Russell net, 567 m.: 1 specimen, 130 mm.

St. 1660. 27. i. 36. 74° 46·4′ S, 178° 23·4′ E. Large otter trawl, 351 m.: 11 specimens, 61–145 mm.

Depth of body 4 to $5\frac{1}{2}$ in the length, length of head 3 to $3\frac{3}{4}$. Snout shorter than eye, diameter of which is $2\frac{4}{5}$ to $3\frac{1}{3}$ in length of head; interorbital width about 12. Jaws about equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ of eye; occiput, interorbital region, cheeks and opercles scaly; praeorbital sometimes scaly, sometimes incompletely scaled or nearly naked; 10 to 13 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 46 to 54 in a longitudinal series from above base of pectoral to caudal; 10 to 23 in upper lateral line, which rarely extends beyond extremity of pectoral fin; lower lateral line without tubular scales. Dorsal IV–VI, 31–36. Anal 29–33. Pectoral with 20 to 22 rays, $\frac{3}{5}$ to $\frac{3}{4}$ head, about as long as pelvics, which reach vent or anal fin. Caudal rounded; caudal peduncle as long as deep or rather deeper than long. Brownish, with dark spots or irregular cross-bars; spinous dorsal with a deep black blotch; soft dorsal and anal with a blackish band which is broadest and most intense posteriorly, that on the dorsal sometimes reduced to a deep black blotch on posterior part of fin; caudal, pectorals and pelvics often barred.

Hab. Graham Land and neighbouring islands; South Shetlands; Enderby Land; Mac-Robertson Land; Princess Elizabeth Land; Queen Mary Land; South Victoria Land; near King Edward Land.

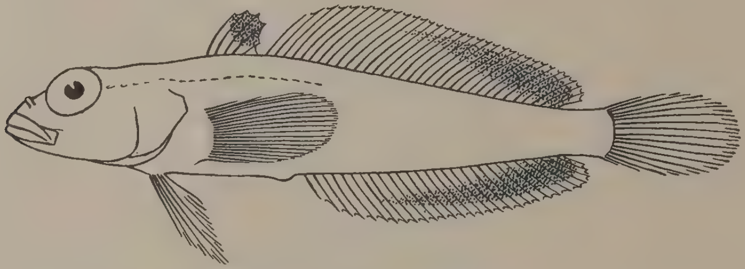

Fig. 22. *Trematomus scotti.* × $\frac{3}{4}$.

The type of the species, 110 mm. in total length, is from off the Ross Barrier at a depth of 562 metres. The above description is based upon a large number of specimens, up to 180 mm. in total length, obtained by the 'Terra Nova', 'Discovery' and the B.A.N.Z. Antarctic Research Expedition. The species seems to occur mainly in fairly deep water.

Trematomus lepidorhinus (Pappenheim).

Notothenia lepidorhinus (part), Pappenheim, 1911, *Ges. nat. Freunde Berlin*, No. 8, p. 382; 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. V, p. 169, pl. ix, fig. 1, pl. x, fig. 1; Regan, 1913, *t.c.*, p. 270; Norman, 1937, *t.c.*, p. 71.

Trematomus lepidorhinus, Regan, 1914, *Rep. Brit. Antarct.* (*'Terra Nova'*) *Exped.*, 1910, Zool. I (1), p. 5, pl. iv, fig. 1.

St. 1660. 27. i. 36. 74° 46·4′ S, 178° 23·4′ E. Large otter trawl, 351 m.: 1 specimen, 280 mm.

Depth of body 4 to $4\frac{2}{3}$ in the length, length of head $3\frac{1}{2}$ to $3\frac{3}{4}$. Vent much nearer to tip of snout than to end of anal fin. Snout nearly as long as eye, diameter of which is

3 to $3\frac{2}{3}$ in length of head; interorbital width about 6. Mouth nearly horizontal; jaws about equal anteriorly; maxillary extending to below anterior edge of pupil; upper surface and sides of head, including snout and praeorbital, scaly; 14 to 16 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 72 to 80 in a longitudinal series from above base of pectoral to caudal; 43 to 56 in upper lateral line, which ends behind dorsal or below its posterior rays; 26 to 38 in lower lateral line. Dorsal VI–VII, 31–33. Anal 34–36. Pectoral with 27 to 29 rays, as long as or nearly as long as head, longer than pelvics, which reach vent or anterior rays of anal. Caudal rounded or subtruncate; caudal peduncle somewhat deeper than long. Brownish, with irregular and somewhat indistinct darker cross-bars; spinous dorsal blackish; soft dorsal with dark oblique stripes. The specimen collected by the Discovery Committee has the inside of the mouth and the branchial cavities blackish.

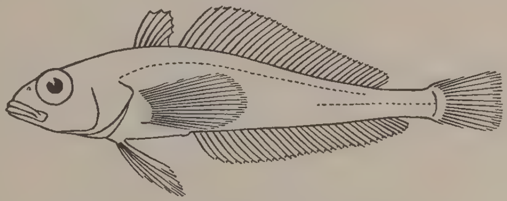

Fig. 23. *Trematomus lepidorhinus*. × $\frac{1}{2}$.

Hab. Mac-Robertson Land; Wilhelm Land; South Victoria Land.

The types, up to 240 mm. in total length, were taken at the Winter Quarters of the 'Gauss', at a depth of 385 metres. There are 3 specimens, 135 to 150 mm. in total length, in the British Museum collection, taken by the 'Terra Nova' from off new land south of the Balleny Islands at a depth of 375 metres.

Trematomus eulepidotus, Regan.

Trematomus eulepidotus, Regan, 1914, *Ann. Mag. Nat. Hist.*, (8) XIII, p. 12; 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.*, 1910, Zool. I (1), p. 5, pl. iv, fig. 3; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 22; Norman, 1937, *t.c.*, p. 71.

St. 167. 20. ii. 27. Off Signy Island, South Orkneys. Net (7 mm. mesh) attached to back of trawl, 244–344 m.: 4 specimens, 90–190 mm.

St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago. Large otter trawl, 160–335 m.: 1 specimen, 163 mm.

St. 1660. 27. i. 36. 74° 46·4′ S, 178° 23·4′ E. Large otter trawl, 351 m.: 1 specimen, 255 mm.

Depth of body $3\frac{1}{2}$ to $4\frac{1}{2}$ in the length, length of head $3\frac{1}{4}$ to $3\frac{3}{4}$. Vent nearly equidistant from tip of snout and end of anal fin. Snout shorter than eye, diameter of which is $3\frac{1}{4}$ to $3\frac{3}{4}$ in length of head; interorbital width $4\frac{1}{2}$ to $5\frac{1}{2}$. Mouth oblique; jaws about equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ of eye; head covered with scales, only the lips naked; 12 to 15 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 67 to 76 in a longitudinal series from above base of pectoral to caudal; 40 to 48 in upper lateral line, which generally ends below posterior rays of dorsal; 10 to 22 in lower lateral line. Dorsal VI–VII, 34–37. Anal 32–34. Pectoral with 27 or 28 rays, $\frac{3}{4}$ to $\frac{7}{8}$ length of head, longer than pelvics, which reach vent or origin of anal. Caudal subtruncate; caudal peduncle as long as or nearly as long as deep. Pale brownish; sides of body with dark spots connected to form a network; spinous dorsal more or less dusky or blackish distally; soft dorsal with oblique dark stripes.

Hab. Palmer Archipelago, Graham Land; South Orkneys; Enderby Land; MacRobertson Land; Queen Mary Land; South Victoria Land.

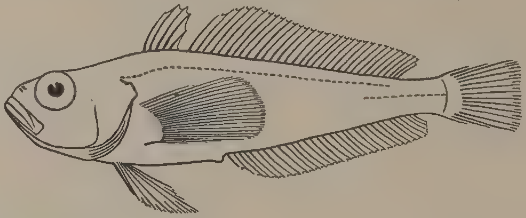

Fig. 24. *Trematomus eulepidotus.* × $\frac{1}{2}$.

The types of this species, 140 and 165 mm. in total length, are from the entrance to McMurdo Sound, 300 metres, and from near Inaccessible Island, 416 to 452 metres. *Trematomus eulepidotus* is closely related to *T. lepidorhinus*, but differs in the shorter snout, broader interorbital region, more oblique mouth, shorter tail, more numerous dorsal rays, and much shorter lower lateral line.

Genus DISSOSTICHUS

Dissostichus, Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 3; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 279; Norman, 1937, *Discovery Rep.*, XVI, p. 91. Type *Dissostichus eleginoides*, Smitt.

Differs from *Trematomus* in the longer snout and strongly projecting lower jaw; teeth in the upper jaw biserial, those of the outer row enlarged, spaced, canine-like; a group of stronger teeth on each praemaxillary; teeth of lower jaw uniserial, spaced, canine-like.

Two species; one from the Patagonian region, one from the Antarctic Zone.

Coasts of the Antarctic Continent and northwards to the Patagonian region and the coast of Argentina.

Dissostichus mawsoni, Norman.

Dissostichus eleginoides (*non* Smitt), Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 3, p. 139; 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 36.

Dissostichus mawsoni, Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped*, Ser. B, I, p. 71, fig. 6.

Depth of body $5\frac{1}{2}$ to nearly 6 in the length, length of head about 3. Snout $1\frac{1}{4}$ to $1\frac{3}{5}$ times as long as eye, diameter of which is 4 to $5\frac{1}{4}$ in length of head; interorbital width $4\frac{1}{2}$ to 5. Maxillary extending to below middle of eye or a little beyond; upper surface of head to below middle or anterior edges of eyes, cheeks and opercles scaly; no elongate naked areas on upper surface of head; 12 or 13 gill-rakers on lower part of anterior arch. 135 to 150 scales in a longitudinal series from above base of pectoral to caudal; 90 to 96 in upper lateral line, which ends below posterior rays of dorsal; 35 to 38 in lower lateral line, which does not extend forward as far as level of middle of anal fin. Dorsal VIII–IX, 25–27. Anal 25–26. Pectoral with 27 to 29 rays, nearly $\frac{3}{4}$ length of head, much longer than pelvics, which do not nearly reach vent. Caudal truncate or a little rounded; caudal peduncle longer than deep. More or less uniformly brownish, or with 4 irregular and incomplete dark cross-bars and with some dark spots; spinous dorsal blackish distally, sometimes with a dark horizontal band near the base; traces of oblique dark stripes on soft dorsal and anal; caudal pectorals and pelvics plain.

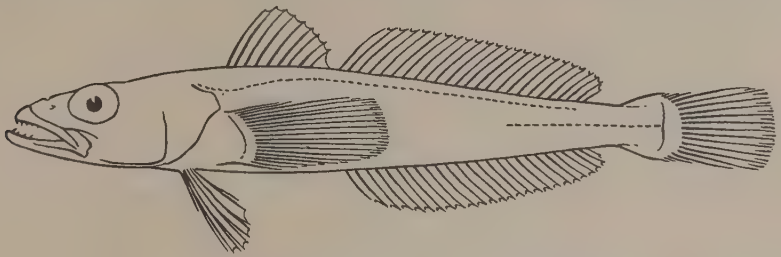

Fig. 25. *Dissostichus mawsoni*. × about ½.

Hab. Graham Land; off Mac-Robertson Land.

The type of the species, 370 mm. in total length, is from 66° 45′ S, 62° 03′ E, at a depth of 219 metres. The specimens collected by the 'Français' are from Booth Wandel Island, 20 to 30 metres. I have examined four of these in the Paris Museum (No. 06—140–143), 212 to 262 mm. in total length, and, although the skin has been largely rubbed off the head region, I have little doubt that they are referable to this species.[1]

Dissostichus mawsoni may be readily distinguished from the Patagonian *D. eleginoides* by the absence of the elongate naked areas on the upper surface of the head, the less completely scaled interorbital region, the somewhat smaller scales on the body, and the shorter lower lateral line.

Genus PLEURAGRAMMA

Pleuragramma, Boulenger, 1902, *Rep. Coll. Nat. Hist. 'Southern Cross'*, p. 187; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 264. Type *Pleuragramma antarcticum*, Boulenger.

Gelidus, Whitley, 1937, *Rec. Austral. Mus.*, XX, p. 19. Type *Pleuragramma antarcticum*, Boulenger.

Body covered with very thin, cycloid scales; 3 lateral lines; each lateral line scale with a notched hinder margin and with a vertical row of three shallow pits. Mouth of moderate size, the lower jaw strongly projecting; jaws with bands of villiform teeth; one or two pairs of somewhat larger teeth at the praemaxillary symphysis. Snout flattened, but not spatulate. Gill-membranes narrowly united, free from the isthmus. Skeleton feebly ossified, with parapophyses developed only on the posterior praecaudal vertebrae; vertebrae 53 (19 + 34); hypercoracoid enclosing its foramen.

A single species.

Coasts of the Antarctic Continent.

There would appear to be no justification for the introduction of a new name for this genus, since, under the International Rules of Nomenclature, *Pleuragramma*, Boulenger, cannot be regarded as invalidated by *Pleurogrammus*, Gill. Further, the meanings of the two words are quite different, Gill's genus being for a fish with 5 lateral lines on each side, Boulenger's for a fish believed to be without any lateral line. Mr Whitley has also erected a new family (Gelididae) for its reception, pointing out that Boulenger was in error in placing this fish in the family Leptoscopidae. Regan, however, in his monograph of the Nototheniiformes published in 1913, has clearly demonstrated the close affinities of *Pleuragramma* and *Trematomus*.

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[1] One of these specimens has now been received in exchange from the Paris Museum

Pleuragramma antarcticum, Boulenger.

Pleuragramma antarcticum, Boulenger, 1902, *t.c.*, p. 187, pl. xviii; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 49; Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 3, p. 139; 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 48, figs. 3, 4; Boulenger, 1907, *Nat. Antarct. Exped. Nat. Hist.*, II, Fish., p. 4; Waite, 1911, *Brit. Antarct. Exped.*, 1907–1909, II, Biol., II, p. 14; Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. v, p. 164; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 264; 1914, *Rep. Brit. Antarct. ('Terra Nova') Exped.* 1910, Zool. I (1), p. 6; 1916, *ibid.* Zool. I (4), p. 131, pl. ii, figs. 3–6; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 22; Nichols and LaMonte, 1936, *Amer. Mus. Novit.*, 839, p. 1; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 72.

Gelidus antarcticus, Whitley, 1937, *Rec. Austral. Mus.*, XX, p. 20, fig. 5.

St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago. Nets (4 mm. and 7 mm. mesh) attached to back of trawl, 160–335 m.: 1 specimen, 160 mm.

St. 182. 14. iii. 27. Schollaert Channel, Palmer Archipelago. Large otter trawl, 278–500 m.: 1 specimen, 200 mm.

St. WS 506. 7. ii. 30. 70° 31′ S, 81° 36′ W. Picked up dead at surface: 1 specimen, 185 mm.

St. —. 20. i. 36. Bay of Whales (78° 24·85′ S, 164° 10·3′ W). Picked up dead at surface: 1 specimen, 173 mm.

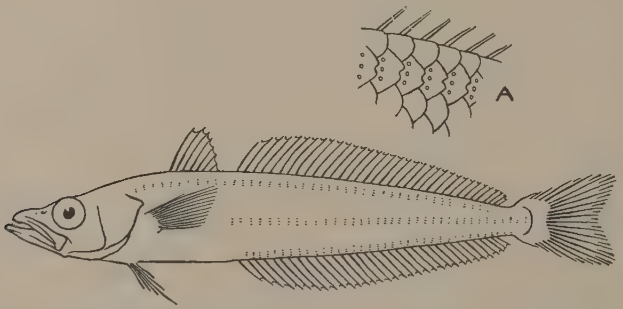

Fig. 26. *Pleuragramma antarcticum.* × ½. A, Lateral line scales (enlarged).

Depth of body 5 to 6 in the length, length of head 3½ to 4. Snout as long as or longer than eye, diameter of which is 3¼ to 4 in length of head; interorbital width 5 to 6. Maxillary extending to below anterior ⅓ of eye; upper surface of head naked; cheeks and opercles scaly; 20 to 25 gill-rakers on lower part of anterior arch. 50 to 58 scales in a longitudinal series from above base of pectoral to caudal; about 45 notched scales in upper lateral line, which ends below last rays of dorsal; about 35 in both middle and lower lateral lines. Dorsal VI–VII, 33–38. Anal 36–39. Pectoral with 20 or 21 rays, ½ to ⅗ length of head, as long as or longer than pelvics, which scarcely reach the vent. Caudal slightly emarginate; caudal peduncle about as deep as long. Silvery, back darker; back and sides powdered with blackish dots; fins all pale.

Hab. Circumpolar in the Glacial District (see p. 97).

The types of the species, up to 165 mm. in total length, are from the ice barrier, Victoria Land, at 78° 35′ S. Regan has described and figured several larval and post-larval specimens from the Ross Sea and the coast of Victoria Land, and points out that in these the eye is proportionately smaller than in the adult fish, no doubt because the latter descend to greater depths. He has shown that larval and post-larval examples have been taken not far from the coast and at depths not exceeding 80 metres; young fish (30 to 35 mm.) in the Ross Sea at a depth of 356 metres. The B.A.N.Z. Antarctic Research Expedition obtained larger young (65 to 82 mm.) in 66° 36·5′ S, 141° 44′ E, with tow-nets hauled obliquely from 0 to 111 metres, and in 68° 14′ S, 70° 11′ E, with hand-nets at the surface (the fish being frozen and seen floating past the ship). The 'Aurora' obtained many young (*c.* 70 mm.) in 66° 8′ S, 94° 17′ E, at a depth of 20 metres. Adults have been taken at various localities, and generally at depths ranging from about 150 to 500 metres. A number of specimens have been recorded frozen on the ice barrier or at the surface of the sea, and others have been taken from the stomachs of seals or penguins.

Family HARPAGIFERIDAE

Closely related to the Nototheniidae, but with the body naked; two lateral lines, the upper always with tubules, the lower sometimes reduced to a series of pores; gill-membranes broadly united to the isthmus, not forming a fold across it; operculum hooked upwards posteriorly, its upper edge deeply concave.

Five genera, all occurring in the Antarctic Zone, and one (*Harpagifer*) extending into the Subantarctic Zone.

Key to the Genera

I. A mental barbel present; opercles not spinate.
  A. Post-temporal not prominent; head not or scarcely broader than deep; interorbital region narrow.
    1. Spinous dorsal fin above base of pectoral ... ... 1. *Artedidraco.*
    2. Spinous dorsal fin above operculum ... ... 2. *Dolloidraco.*
  B. Upper limb of post-temporal projecting as a prominent curved ridge; spinous dorsal fin above operculum.
    1. Head longer than broad, scarcely broader than deep; interorbital region narrow. 3. *Histiodraco.*
    2. Head nearly as broad as long, much broader than deep; interorbital region wide or rather wide ... ... 4. *Pogonophryne.*
II. No mental barbel; operculum and suboperculum each forming a prominent spine. 5. *Harpagifer.*

Genus ARTEDIDRACO

Artedidraco, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 39; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 280. Type *Artedidraco skottsbergi*, Lönnberg.

A comparatively short upper lateral line with tubules; lower lateral line reduced to a series of pores. Head not or scarcely broader than deep; snout shorter than eye;

interorbital region narrow; post-temporal not prominent; opercles not spinate. Mouth of moderate size; a mental barbel present; teeth in villiform bands, without distinct canines. Spinous dorsal fin placed above the base of the pectoral. Vertebrae 38 (15+23).

Five species.

Coasts of the Antarctic Continent, extending northwards in the Weddell Quadrant to South Georgia.

Key to the Species

I. Maxillary not extending beyond anterior $\frac{1}{3}$ of eye; dorsal II–IV, 23–28; anal 16–21.
A. Eye $3\frac{1}{2}$ to 4 in head; barbel club-shaped, with papillose terminal knob, in the male, without distal expansion in the female, its length from less than $\frac{1}{4}$ to nearly $\frac{1}{3}$ that of head.
1. Depth 4 to $4\frac{1}{3}$ in length; last ray of anal joined or nearly joined to base of caudal; pelvic fins not nearly reaching vent ... ... 1. *mirus.*
2. Depth 5 to $5\frac{1}{2}$ in length; last ray of anal separated by an interspace from caudal; pelvic fins reaching vent or origin of anal ... ... 2. *orianae.*
B. Eye $2\frac{4}{5}$ to $3\frac{3}{5}$ in head; barbel without distal expansion in both sexes, either smooth, finely papillose, or slightly fringed, its length never more than $\frac{1}{4}$ that of head.
1. Caudal fin rounded or subtruncate; dorsal II–IV, 24–27 ... ... 3. *skottsbergi.*
2. Caudal fin slightly emarginate; dorsal II–III, 26–28 ... ... 4. *loennbergi.*

II. Maxillary extending to or nearly to below middle of eye; dorsal III–V, 27–30; anal 19–20; eye $3\frac{1}{2}$ to $3\frac{3}{4}$ in head; barbel smooth, tapering, its length $\frac{1}{5}$ to more than $\frac{1}{4}$ that of head.
5. *shackletoni.*

Artedidraco mirus, Lönnberg.

Artedidraco mirus, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 40, pl. i, fig. 4, pl. iv, fig. 14; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 280.

St. MS 71. 9. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 110–60 m.: 1 specimen, 73 mm.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 1 specimen, 100 mm.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: 1 specimen, 93 mm.

St. WS 25. 17. xii. 26. Undine Harbour (North), South Georgia. Small beam trawl, 18–27 m.: 2 specimens, 65, 70 mm.

St. 140. 23. xii. 26. Stromness Harbour to Larsen Point, South Georgia. Large otter trawl, 122–136 m.: 12 specimens, 33–107 mm.

St. 142. 30. xii. 26. East Cumberland Bay, South Georgia. Net (7 mm. mesh), attached to back of trawl, 88–273 m.: 1 specimen, 105 mm.

St. 148. 9. i. 27. Off Cape Saunders, South Georgia. Large otter trawl, with net (4 mm. mesh) attached, 132–148 m.: 2 specimens, 92, 100 mm.

St. 149. 10. i. 27. Mouth of East Cumberland Bay, South Georgia. Large otter trawl, 200–234 m.: 4 specimens, 95–115 mm.

Depth of body 4 to $4\frac{1}{3}$ in the length, length of head $2\frac{3}{4}$ to a little more than 3. Diameter of eye $3\frac{1}{2}$ to 4, interorbital width about 9 in length of head. Maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{3}$ of eye; barbel from less than $\frac{1}{4}$ to nearly $\frac{1}{3}$ length of head, with a papillose terminal knob in the male, smooth and without distal expansion in the female; 6 or 7 gill-rakers on lower part of anterior arch. Upper lateral line short, ending below anterior part of soft dorsal. Dorsal III, 23–25; middle rays of soft dorsal longest, the last joined to base of caudal; fins higher in adult males. Anal 16–18; last ray joined or nearly joined to base of caudal. Pectoral with 16 or 17 rays, $1\frac{3}{5}$ to $1\frac{2}{3}$ in length of head, extending to above vent or origin of anal; pelvics a little shorter, not nearly reaching vent. Caudal subtruncate or rounded. Four dark cross-bars on back, extending upwards on the dorsal fins, the first at the base of the spinous dorsal, the second small and inconspicuous; a dark patch on praeorbital and another on cheek; lower parts of body irregularly spotted and marbled; fins with series of spots, the dorsal sometimes more or less dusky, the anal blackish with a pale margin; all the markings sometimes very faint.

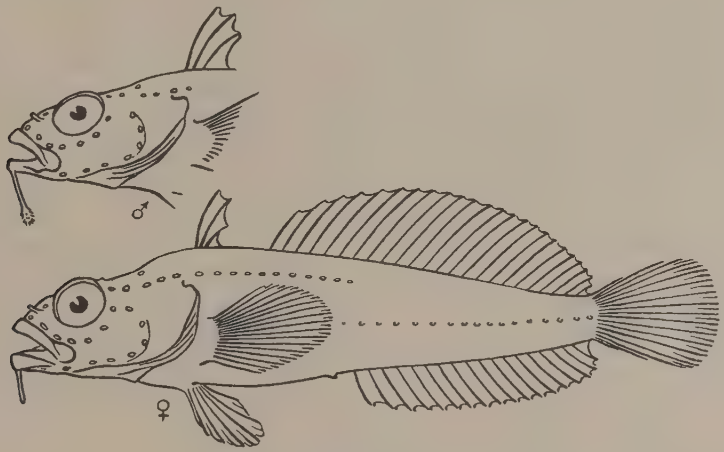

Fig. 27. *Artedidraco mirus*. × 1.

Hab. South Georgia.

This species was originally described from 4 specimens, 40 to 92 mm. in length without the caudal fin, from Antarctic Bay and Cumberland Bay, at depths varying from 22 to 250 metres. It was not previously represented in the British Museum collection.

Artedidraco orianae, Regan.

Artedidraco orianae, Regan, 1914, *Ann. Mag. Nat. Hist.*, (8) XIII, p. 12; 1914, *Rep. Brit. Antarct.* (‘*Terra Nova*’) *Exped.*, 1910; Zool. 1 (1), p. 7, pl. vi, fig. 2.

Depth of body 5 to $5\frac{1}{2}$ in the length, length of head $2\frac{5}{6}$ to 3. Diameter of eye $3\frac{1}{2}$, interorbital width 10 in length of head. Maxillary extending to below anterior $\frac{1}{4}$ of eye; barbel $\frac{1}{4}$ length of head, club-shaped, with papillose distal expansion; 7 short gill-rakers on lower part of anterior arch. Upper lateral line of moderate length, extending to or nearly to below middle of soft dorsal. Dorsal III–IV, 25; rays of soft dorsal decreasing from third or fourth; last adnate to caudal peduncle. Anal 17–18; separated by an interspace from caudal fin. Pectoral with 17 rays, $\frac{5}{7}$ or $\frac{3}{4}$ length of head, extending to above third or fourth ray of anal; pelvics as long, extending to vent or origin of anal.

Caudal subtruncate. Five dark bars on back, extending upwards on the dorsal fins, the first at base of spinous dorsal, the second and fourth stronger than the rest; a spot on praeorbital, another on cheek; lower part of body irregularly spotted; fins with series of spots.

Hab. South Victoria Land.

Known only from the types, 2 specimens, each 80 mm. in total length, from off Cape Adare, 85 to 95 metres.

Artedidraco skottsbergi, Lönnberg.

Artedidraco skottsbergi, Lönnberg, 1905, *t.c.*, p. 48, pl. iv, fig. 15; Regan, 1913, *t.c.*, p. 280; Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 3, p. 139; 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 46; Regan, 1914, *Rep. Brit. Antarct.* (*'Terra Nova'*) *Exped.* 1910, Zool. 1 (1), p. 7, pl. v, fig. 1; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, 1, p. 73.

St. 599. 17. i. 31. 67° 08′ S, 69° 06$\frac{1}{2}$′ W. Large dredge, 203 m.: 1 specimen, 85 mm.

Depth of body $4\frac{1}{2}$ to nearly 6 in the length, length of head 3 to $3\frac{1}{2}$. Diameter of eye 3 to $3\frac{3}{5}$, interorbital width about 14 to 20 in length of head. Maxillary extending to below anterior $\frac{1}{5}$ or $\frac{1}{4}$ of eye; barbel less than $\frac{1}{2}$ diameter of eye, simple, smooth or finely papillose; 7 gill-rakers on lower part of anterior arch. Dorsal II–IV, 24–27; middle soft rays longest. Anal 17–20. Last rays of dorsal and anal joined or nearly joined to base of caudal. Pectoral with 15 to 17 rays, $1\frac{1}{6}$ to $1\frac{2}{5}$ in length of head, extending to above vent or origin of anal; pelvics shorter, scarcely reaching vent in young, not as far in adult. Caudal rounded or subtruncate. Body with numerous irregular dark spots; a series of blotches at base of dorsal fin sometimes continued on sides of body as bars; vertical fins with series of spots on the rays, those on posterior part of dorsal and anal and near upper and lower edges of caudal deep black; pectorals barred.

Hab. Graham Land; South Shetlands; Enderby Land; Mac-Robertson Land; South Victoria Land.

The type of the species, 57 mm. in length without the caudal fin, was taken south of Snow Hill, Graham Land, at a depth of 125 metres. In addition to the specimen collected by the Discovery Committee, the above description is based upon 18 specimens in the British Museum collection, up to 120 mm. in total length, and 13 others, 45 to 107 mm. long, collected by the B.A.N.Z. Antarctic Research Expedition. I have also seen a specimen, 70 mm. in total length, in the Paris Museum (No. 06—152). This is from Booth Wandel Island, at a depth of 40 metres.

Artedidraco loennbergi, Roule.

Artedidraco loennbergi, Roule, 1913, *Bull. Mus. Paris*, 1913, No. 1, p. 4.
Artedidraco loenbergi, Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 13, pl. iv, fig. 4.
Artedidraco loennbergii, Regan, 1914, *Rep. Brit. Antarct.* (*'Terra Nova'*) *Exped.* 1910, Zool. 1 (1), p. 8, pl. v, fig. 2.

Depth of body 5 to 6 in the length, length of head $2\frac{3}{4}$ to $4\frac{1}{4}$. Diameter of eye $2\frac{4}{5}$ to $3\frac{1}{2}$, interorbital width 15 to 20 in length of head. Maxillary extending to below anterior $\frac{1}{4}$ of eye; barbel $\frac{1}{7}$ to $\frac{1}{4}$ length of head, simple or slightly fringed distally; 6 or 7 gill-rakers on lower part of anterior arch. Dorsal II–III, 25–28. Anal 18–21. Soft dorsal and anal usually highest posteriorly, their last rays joined or nearly joined to base of caudal. Pectoral with 14 to 16 rays, $1\frac{2}{5}$ to $1\frac{3}{5}$ in length of head, extending to above anal in young but not in adult; pelvics as long as or a little shorter than pectorals, reaching vent in young but not in adult. Caudal slightly emarginate. A series of dark blotches at base of dorsal fin and sometimes at base of anal; a dark lateral band, made up of irregular spots, from eye to caudal fin; pale bands above and below it are continued along the upper and lower margins of the caudal fin; dorsal and middle of caudal with spots on the rays; pectorals usually barred.

Hab. Graham Land; South Victoria Land.

The type of the species, 93 mm. in total length, was collected by the 'Pourquoi Pas?' near Marguerite Bay (68° 00′ S, 70° 20′ W), at a depth of 230 metres. I have examined this type in the Paris Museum (No. 13—186). It has a somewhat larger eye than is seen in examples from Victoria Land, but appears to be otherwise identical. The 'Terra Nova' obtained 22 specimens, measuring up to 110 mm. in total length, from: Ross Sea, 74° 25′ S, 179° 3′ E, 295 metres; off new land south of the Balleny Islands, 375 metres; entrance to McMurdo Sound, 76° 56′ S, 164° 12′ E, 300 metres and 77° 13′ S, 164° 18′ E, 380 metres; and near Inaccessible Island, 415 to 450 metres.

Artedidraco shackletoni, Waite.

Artedidraco shackletoni, Waite, *Brit. Antarct. Exped.* 1907–1909, II, Biol., II, p. 15, pl. ii; Regan, 1914, *t.c.*, p. 8; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser C, III (1), Fishes, p. 23; Norman, 1937, *t.c.*, p. 73.

Depth of body 4 to 5 in the length, length of head $2\frac{3}{4}$ to nearly 3. Diameter of eye $3\frac{1}{2}$ to $3\frac{3}{4}$, interorbital width about 14 in length of head. Maxillary extending to below middle of eye or not quite as far; barbel as long as or nearly as long as diameter of eye and $\frac{1}{5}$ to more than $\frac{1}{4}$ length of head, smooth, tapering; 6 or 7 gill-rakers on lower part of anterior arch. Dorsal III–IV (V), 27–30; middle soft-rays longest. Anal 19 or 20. Last rays of dorsal and anal joined to base of caudal. Pectoral with 15 to 17 rays, $1\frac{2}{5}$ to $1\frac{3}{4}$ in length of head, extending to above vent or origin of anal; pelvics as long or shorter, not reaching vent (except in young). Caudal subtruncate. Pale brownish, uniform or with three dark brown bars on the back; lower parts of hinder portion of body sometimes spotted with brown; caudal and pectoral fins spotted, and sometimes traces of spots on the other fins; often a dusky band along base of anal fin.

Hab. Enderby Land; Mac-Robertson Land; Queen Mary Land; South Victoria Land.

The type of the species, 146 mm. in length, was from off Cape Royds, at a depth of 56 to 150 metres. Two specimens (132 and 142 mm.) in the British Museum collection, from the entrance to McMurdo Sound, and 6 specimens (65 to 120 mm.) collected by the B.A.N.Z. Antarctic Research Expedition are also included in the above description.

Genus DOLLOIDRACO

Dolloidraco, Roule, 1913, *Bull. Mus. Paris*, 1913, No. 1, p. 5; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 15. Type *Dolloidraco longedorsalis*, Roule.

Differs from *Artedidraco* in having the spinous dorsal fin placed above the operculum.

A single species.

Coasts of the Antarctic Continent.

Dolloidraco longedorsalis, Roule.

Dolloidraco longedorsalis, Roule, 1913, *Bull. Mus. Paris*, 1913, No. 1, p. 6; Roule, Angel and Despax, 1913, *t.c.*, p. 16, pl. iv, figs. 1–3; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 24, pl. i, fig. 2, text-fig. 3.

Dolloidraco longidorsalis, Regan, 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. 1 (1), p. 28.

St. 1644. 16. i. 36. Bay of Whales (78° 24·85′ S, 164° 10·3′ W). Russell Bottom Net, 626 m.: 1 female specimen, 115 mm.

Depth of body about 5 in the length, length of head $2\frac{1}{2}$ to $2\frac{4}{5}$. Diameter of eye $2\frac{1}{2}$ to $2\frac{3}{4}$ in length of head; interorbital space very narrow. Maxillary extending to below anterior margin of pupil or beyond; barbel about as long as diameter of eye, simple (females?) or with a terminal expansion (males ?); 6 small, knob-like gill-rakers on lower part of anterior arch. Dorsal III 22–25. Anal 14–15. Last rays of dorsal and anal well separated from base of caudal. Pectoral with 16 or 17 rays, about $\frac{3}{4}$ length of head, extending to above anterior part of anal; pelvics shorter, just reaching vent. Caudal subtruncate or a little rounded. Yellowish-brown, becoming darker on hinder part of body; a dark patch on cheek below eye, and a dusky vertical bar across the operculum; spinous dorsal dusky; soft dorsal mainly dusky; anal black in its basal half, white distally; caudal white, with an incomplete oblique black bar across the base and a broader and more distinct oblique bar across its distal portion, the two being connected by black spots along the upper edge of the fin; pectorals with indistinct darker cross-bars, the lower rays more or less blackish; pelvics dusky in their basal parts.

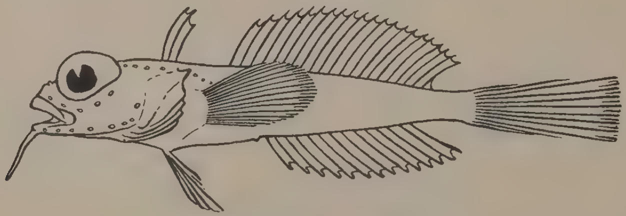

Fig. 28. *Dolloidraco longedorsalis*. × $\frac{3}{4}$.

Hab. Graham Land; Queen Mary Land; South Victoria Land.

This species was originally described from 6 specimens, 72 to 89 mm. in length without the caudal fin, of which one is now in the British Museum collection, all from

Marguerite Bay, 230 metres[1]. In all these specimens the barbel is simple. Of the 7 specimens, 100 to 137 mm. in total length, taken by the 'Aurora' at Queen Mary Land, 610 to 670 metres, some have a simple barbel, but in others this has a distal expansion. In the specimen obtained by the Discovery Committee, which I have ascertained is a female, the barbel is simple. Thus, it appears probable that this is a secondary sexual character as in *Artedidraco mirus*.

Genus **HISTIODRACO**

Histiodraco, Regan, 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. I (1), p. 9. Type *Dolloidraco velifer*, Regan.

Differs from *Dolloidraco* in that the upper limb of the post-temporal projects as a prominent curved ridge.

A single species.

Coasts of the Antarctic Continent.

Histiodraco velifer (Regan).

Dolloidraco velifer, Regan, 1914, *Ann. Mag. Nat. Hist.*, (8) XIII, p. 12.

Histiodraco velifer, Regan, 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. I (1), p. 9, pl. v, fig. 3; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 74.

Depth of body 4 to 4½ in the length, length of head 2⅓ to 2⅖. Diameter of eye 3½ to 3¾, interorbital width about 12 in length of head. Maxillary extending to below middle of eye or beyond; lower jaw rather strongly projecting; barbel ⅖ to more than ½ length of head, fringed in its distal half; 7 very short, knob-like gill-rakers on lower part of anterior arch. Dorsal II–III, 26; spinous dorsal short and high; soft dorsal sometimes more or less elevated anteriorly, the highest rays ⅗ to $\frac{9}{10}$ length of head. Anal 17. Pectoral with 18 or 19 rays, about ½ length of head, longer than pelvics, which do not reach vent. Caudal truncate above, rounded below. Body marbled or irregularly barred with darker brown; fins more or less spotted; a dark bar at base of pectoral and another across the caudal.

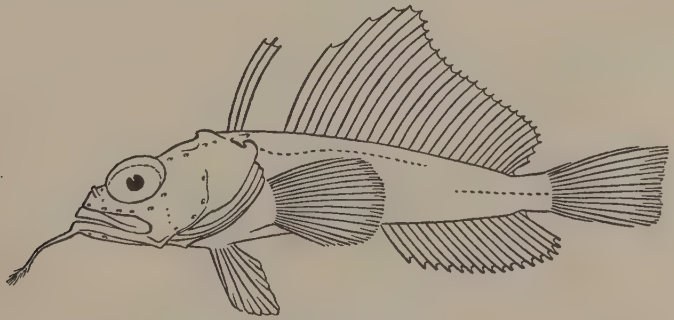

Fig. 29. *Histiodraco velifer*. × ½.

Hab. Mac-Robertson Land; South Victoria Land.

The types, 2 specimens 180 and 190 mm. in total length, are from the entrance to McMurdo Sound, 77° 13′ S, 164° 18′ E, at a depth of 385 metres. Two other examples

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[1] I have seen 4 types in the Paris Museum (No. 13—187–190), 100 to 120 mm. in total length.

(150 and 170 mm.) from 66° 45′ S, 62° 03′ E, 219 metres, collected by the B.A.N.Z. Antarctic Research Expedition, are also included in this description.

Genus **POGONOPHRYNE**

Pogonophryne, Regan, 1914, *Ann. Mag. Nat. Hist.*, (8) xiii, p. 13; 1914, *Rep. Brit. Antarct.* (‘*Terra Nova*’) *Exped.* 1910, Zool. I (1), p. 9. Type *Pogonophryne scotti*, Regan.

Differs from *Histiodraco* in the wider interorbital region and the strongly depressed head, nearly as broad as long and much broader than deep; both lateral lines with tubules.

Two species.

Coasts of the Antarctic Continent and neighbouring islands.

Pogonophryne scotti, Regan.

Pogonophryne scotti, Regan, 1914, *t.c.*, p. 13; 1914, *t.c.*, p. 9, pl. vi, fig. 1; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, iii (1), Fishes, p. 26.

St. 1660. 27. i. 36. 74° 46·4′ S, 178° 23·4′ E. Large otter trawl, 351 m.: 2 specimens, 240, 250 mm.

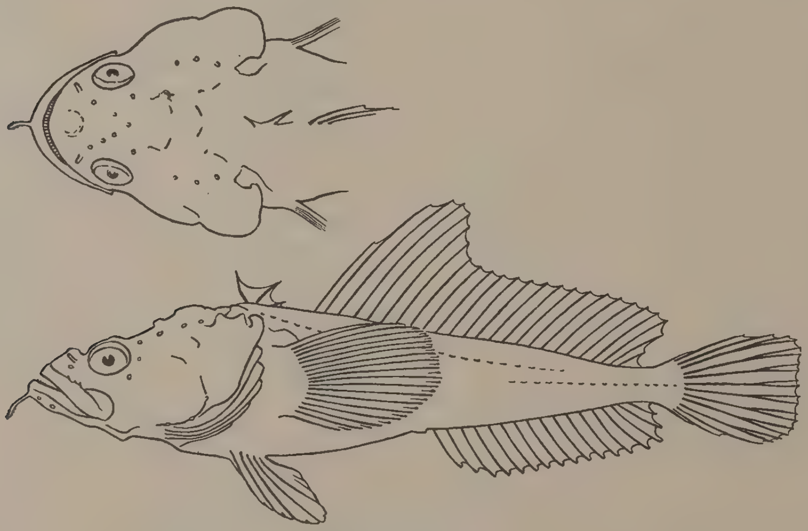

Fig. 30. *Pogonophryne scotti.* × ½.

Depth of body about 4 in the length, length of head $2\frac{1}{2}$ to $2\frac{4}{5}$. Head $1\frac{1}{4}$ to $1\frac{1}{3}$ times as long as broad. Diameter of eye $5\frac{1}{2}$ to $5\frac{3}{4}$, interorbital width about $4\frac{1}{2}$ in length of head. Maxillary extending to below middle of eye; lower jaw strongly projecting; barbel shorter than diameter of eye, blunt, papillose; 7 to 10 short, knob-like gill-rakers on lower part of anterior arch. Dorsal II–III, 25; spines low; anterior part of soft dorsal sometimes elevated. Anal 17–18. Pectoral with 19 rays, $\frac{1}{2}$ to $\frac{3}{5}$ length of head, extending to above origin of anal; pelvics short, rounded, not nearly reaching vent.

Caudal a little rounded. Body faintly spotted and marbled with darker; a more distinct dark blotch on either side of base of anterior part of soft dorsal; upper surface of head without markings; dorsals, caudal and pectorals with series of dark spots on the rays.

Hab. Queen Mary Land; South Victoria Land.

The type of the species, 290 mm. in total length, is from the Ross Sea, 74° 25′ S, 179° 3′ E, at a depth of 295 metres. The 'Aurora' obtained a single example, 240 mm. in length, from off Drygalski Island at a depth of 112 metres.

Pogonophryne marmoratus, sp.n.

? *Artedidraco skottsbergi*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), pl. ii, fig. 7.

St. 1948. 4. i. 37. 60° 49·4′ S, 52° 40′ W. Rectangular dredge, with Russell net, 490–610 m.: 1 male specimen, 175 mm. Holotype.

Closely related to *P. scotti*, but head about 1$\frac{3}{5}$ times as long as broad; interorbital width more than 7 in length of head; barbel a little longer than diameter of eye, papillose, with terminal expansion. Dorsal II, 25. Anal 16. Upper surface and sides of head and body mottled and spotted with purplish brown; lower parts of body mainly blackish; soft dorsal and pectorals with series of dark spots, sometimes tending to form irregular bars; an irregular dark patch covering part of caudal; anal pale; inner rays of pelvics dusky.

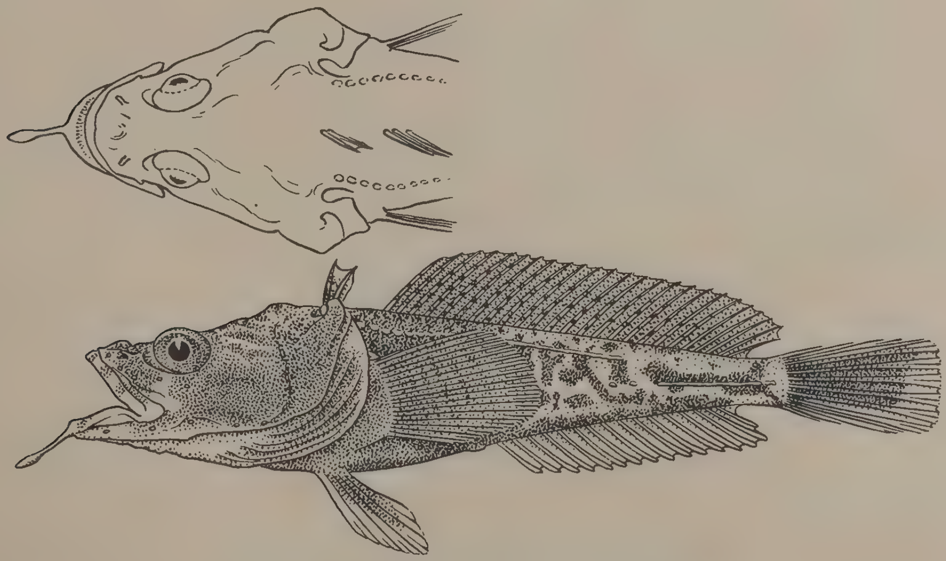

Fig. 31. *Pogonophryne marmoratus*. Holotype. × $\frac{3}{4}$.

Hab. Near the South Shetland Islands.

Regan [1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. 1 (1), p. 9] has suggested that the coloured drawing of a fish from the Bransfield Straits, 849 metres, reproduced by Lönnberg as *Artedidraco skottsbergi*, "seems rather to represent a

Pogonophryne", and it seems probable that the fish in question belonged to the species described above. The barbel is shown without a terminal expansion, but this may be due to the fact that the sketch was prepared in a hurry. Alternatively, the form of the barbel may differ in the sexes, as in *Artedidraco mirus*.

Genus HARPAGIFER

Harpagifer, Richardson, 1844, *Zool. 'Erebus' and 'Terror'* (Fish.), p. 11; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 94; Norman, 1937, *Discovery Rep.*, XVI, p. 94. Type *Batrachus bispinis*, Schneider.

A comparatively short upper lateral line with tubules; lower lateral line reduced to a series of pores; head rather broader than deep; snout about as long as eye; interorbital region of moderate width; post-temporal not prominent; operculum and suboperculum each forming a prominent spine. Mouth rather large; no mental barbel; teeth in villiform bands, without distinct canines. Spinous dorsal fin placed above the base of the pectoral.

A single species.

Patagonian region to Graham Land, Kerguelen and Macquarie Island.

Harpagifer bispinis (Schneider).

Batrachus bispinis, Schneider [*ex* Forster MS.], 1801, in Bloch, *Syst. Ichth.*, p. 45.

Callionymus bispinis, Forster, 1844, *Anim. Mar. Aust.*, p. 360.

Harpagifer bispinis, Richardson, 1844, *Zool. 'Erebus' and 'Terror'* (Fish.), pp. 11, 19, pl. vii, figs. 1–3, pl. xii, figs. 8, 9; Günther, 1860, *Cat. Fish.*, II, p. 263; Gill, 1876, *Bull. U.S. Nat. Mus.*, III, p. 41; Studer, 1879, *Arch. Naturg.*, XLV (1), p. 130; Günther, 1880, *Shore Fish. 'Challenger'*, p. 17; Fischer, 1885, *Jahrb. Hamburg. Wiss. Anst.*, II, p. 57; Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 3, p. 139; 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 45; Roule and Despax, 1911, *Bull. Mus. Paris*, 1911, No. 5, p. 279; Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. V, p. 177, pl. ix, figs. 5*a*, 5*b*; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 13; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 280; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 70; Norman, 1937, *Discovery Rep.*, XVI, p. 94, fig. 46; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, pp. 59, 64.

Harpagifer palliolatus, Richardson, 1844, *t.c.*, p. 20, pl. xii, figs. 5–7.

St. MS 33. 1. v. 25. 1 cable E of Hobart Rock, East Cumberland Bay, South Georgia. Small beam trawl, 40 m.: 1 specimen, 65 mm.

St. WS 25. 17. xii. 26. Undine Harbour (North), South Georgia. Small beam trawl, 18–27 m.: 1 specimen, 37 mm.

St. 145. 7. i. 27. Stromness Harbour, South Georgia. Small beam trawl, 26–35 m.: 1 specimen, 95 mm.

Depth of body $3\frac{3}{4}$ to $4\frac{1}{2}$ in the length, length of head $2\frac{3}{4}$ to $3\frac{1}{4}$. Diameter of eye 4 to 5 in length of head, equal to or rather greater than interorbital width. Jaws equal anteriorly or lower a little projecting; maxillary extending to below middle or anterior part of eye; gill-rakers reduced to a few rudimentary knobs near angle of arch. Dorsal III–V, 21–26. Anal 16–21. Pectoral with 16 to 18 rays, more than $\frac{1}{2}$ as long as head, a little longer than pelvics, which do not reach the vent. Caudal rounded. Coloration very variable; body usually with dark blotches or irregular cross-bars; fins mostly with small dark spots, often united to form narrow bars.

Hab. Graham Land; South Shetlands; South Orkneys; South Georgia; Straits of Magellan; Patagonia; Falkland Islands; Marion Islands; Crozets; Kerguelen; Macquarie Island.

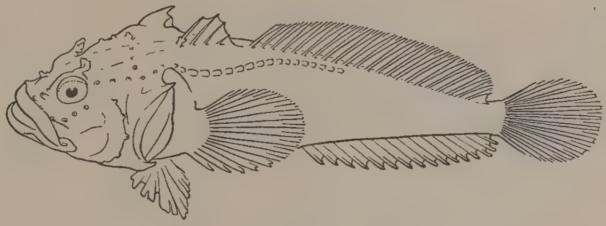

Fig. 32. *Harpagifer bispinis.* × 1.

In addition to the specimens listed above, this description is based upon a large series of examples, up to 100 mm. in total length, in the British Museum collection, and a number of others in the collection of the B.A.N.Z. Antarctic Research Expedition. Schneider's *Batrachus bispinis* was based upon the MS. notes and drawing of Forster (MS IV, 45) of a specimen from the Straits of Magellan. The type of *Harpagifer palliolatus*, 70 mm. in total length, is from the Falkland Islands.

This is mainly a littoral species, occurring in tide pools and under rocks and stones; it is also found in the "kelp" in shallow water.

Family BATHYDRACONIDAE

Closely related to the Nototheniidae and Harpagiferidae, but with the head more or less depressed and the snout usually produced; mouth usually non-protractile; palatine elongate, without lateral ethmoid attachment; gill-membranes attached to the isthmus or forming a fold across it. No spinous dorsal fin.

Eight genera, all confined to the Antarctic Zone.

Key to the Genera

I. Body scaly or with serrated bony plates; snout spatulate; teeth villiform or cardiform, in bands, without canines.
  A. Body without serrated bony plates; lateral line usually complete, but always extending at least as far as middle of dorsal.
    1. A single lateral line, running to or towards middle of base of caudal fin. 1. *BATHYDRACO.*
    2. Two or three lateral lines (at least in adult), the upper always present and running near base of dorsal fin.
      a. Two lateral lines, a long upper one, and a short lower one placed above base of anal fin; snout narrow, more than twice as long as eye; dorsal with 45 to 47 rays, anterior part of fin not elevated; caudal emarginate 2. *GERLACHEA.*

b. Three lateral lines (at least in adult), a long upper one, a short middle one on side of caudal peduncle, and a short lower one above base of posterior part of anal fin; snout broader, not more than $1\frac{1}{2}$ times as long as eye; dorsal with 30 to 37 rays, anterior part of fin forming a fairly distinct lobe; caudal rounded or subtruncate ... ... 3. *RACOVITZIA.*

B. Body quadrangular, with a series of V-shaped, serrated bony plates at each angle, each plate with a backwardly directed spine; a single short lateral line, ending below anterior part of dorsal ... ... 4. *PRIONODRACO.*

II. Body naked.

A. Snout produced, spatulate; teeth in villiform bands, without canines; operculum with divergent ridges, ending in spinous points.

1. Upper lateral line ending below posterior part of dorsal; dorsal with 61 to 66 rays. 5. *CYGNODRACO.*
2. Upper lateral line extending beyond end of dorsal; dorsal with 42 to 46 rays. 6. *PARACHAENICHTHYS.*

B. Snout not spatulate; canine teeth present in one or both of the jaws; operculum with a strong spine terminating in a hooked process.

1. Head and anterior part of body only slightly depressed; no canine teeth in lower jaw; mouth protractile; three lateral lines ... ... 7. *PSILODRACO.*
2. Head and anterior part of body distinctly depressed; strong canine teeth near symphysis of mandibles, exposed in front of snout; mouth not protractile; two lateral lines ... ... 8. *GYMNODRACO.*

Genus BATHYDRACO

Bathydraco, Günther, 1878, *Ann. Mag. Nat. Hist.*, (5) II, p. 18; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 281. Type *Bathydraco antarcticus*, Günther.

Body scaly; a single lateral line, running to or towards middle of base of caudal. Snout produced, spatulate; jaws with bands of small villiform teeth. Operculum with upper edge concave, but without hooked branch posteriorly; gill-rakers well-developed and of moderate length; gill-membranes free from the isthmus, but slightly united anteriorly; 7 branchiostegals.

Five species.

Deep water near the coasts of the Antarctic Continent.

Key to the Species

I. Depth 9 to 10 in length; eye $3\frac{3}{4}$ to 5 in head; dorsal 34–38, anal 29–31; sides of head more or less scaly.

A. 11 to 16 gill-rakers on lower part of anterior arch; lateral line complete.

1. Only the upper half of operculum scaly; cheek completely scaled; 16 gill-rakers on lower part of anterior arch; about 140 scales in a longitudinal series. 1. *antarcticus.*
2. Operculum nearly completely scaly; cheek naked below suborbitals; 11 gill-rakers on lower part of anterior arch; about 125 scales in a longitudinal series. 2. *marri.*
3. A small patch of scales on upper part of operculum; cheek naked below suborbitals; 11 gill-rakers on lower part of anterior arch; about 90 scales in a longitudinal series ... ... 3. *macrolepis.*

B. 19 to 22 gill-rakers on lower part of anterior arch; lateral line ending at some distance from caudal; a small patch of scales on upper part of operculum ... ... 4. *scotiae*.

II. Depth $7\frac{1}{5}$ in length; eye $3\frac{1}{5}$ in head; dorsal 27, anal 22; sides of head naked; 17 gill-rakers on lower part of anterior arch ... ... 5. *nudiceps*.

Bathydraco antarcticus, Günther.

Bathydraco antarcticus, Günther, 1878, *Ann. Mag. Nat. Hist.*, (5) II, p. 18; 1887, *Deep-Sea Fish. 'Challenger'*, p. 47, pl. viii, fig. A; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 282.

Depth of body 9 in the length, length of head 3. Snout $1\frac{1}{3}$ as long as eye, diameter of which is 4 in length of head; interorbital width 20. Lower jaw projecting; maxillary extending to vertical from anterior margin of eye; cheek completely scaled; only the upper half of the operculum scaly; 16 gill-rakers on lower part of anterior arch. About 140 scales in a lateral longitudinal series, about 60 in the lateral line, which is complete. Dorsal 36. Anal 31. Pectoral with 22 rays, truncated, as long as head without snout, extending to above origin of anal; pelvics much shorter, not nearly reaching vent. Caudal subtruncate. Pale brownish, the lower parts somewhat darker; caudal, anal, pelvics and lower parts of pectorals dusky.

Hab. South-east of Heard Island, 2300 metres.

Known only from the type of the species, 260 mm. in total length.

Bathydraco marri, sp.n.

St. 1658. 26. i. 36. 76° 09·6′ S, 168° 40′ E. Rectangular dredge, with Russell net, 520 m.: 1 specimen, 112 mm. Holotype.

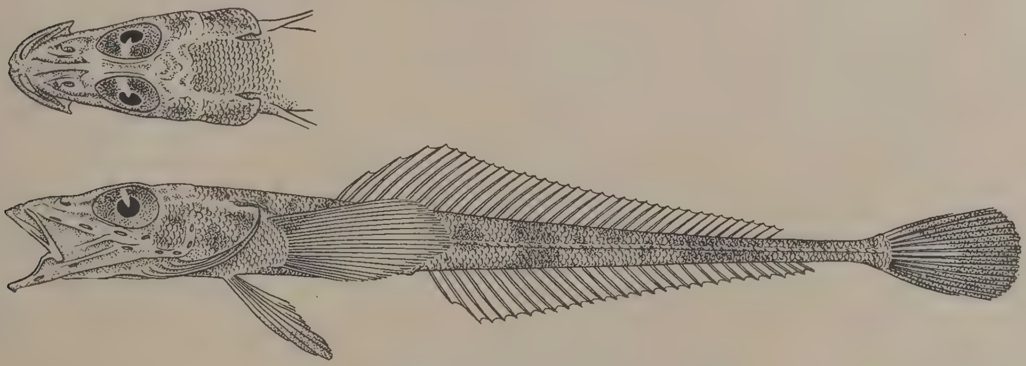

Fig. 33. *Bathydraco marri.* Holotype. × $1\frac{1}{2}$.

Depth of body about 9 in the length, length of head $3\frac{2}{5}$. Snout slightly longer than eye, diameter of which is $3\frac{3}{4}$ in length of head; interorbital width about 12. Lower jaw a little projecting; maxillary not reaching vertical from anterior margin of eye; cheek naked below the suborbitals, but a large patch of scales on the praeoperculum and operculum; 11 gill-rakers on lower part of anterior arch. About 125 scales in a lateral longitudinal series, about 55 in the lateral line, which is complete. Dorsal 36. Anal 29. Pectoral with 22 rays, as long as head without snout, extending to a little beyond origin of anal; pelvics shorter, not reaching vent. Caudal a little rounded (?). Pale yellowish-brown, with about 6 irregular dark patches on the back, of which 2 extend downwards on the sides and reach the anal fin; a number of irregular dark spots and blotches on sides of body and on the head; a dark longitudinal band near base of dorsal; caudal blackish, except at its base; a dusky patch on upper part of base of pectoral; pelvics a little dusky in their distal parts; anal pale.

Hab. Ross Sea.

This species is apparently most nearly related to *B. macrolepis*, Boulenger. I have much pleasure in naming it after Mr J. W. S. Marr, a member of the Discovery Committee's scientific staff.

Bathydraco macrolepis, Boulenger.

Bathydraco macrolepis, Boulenger, 1907, *Nat. Antarct. Exped. Nat. Hist.*, II, Fish., p. 4, pl. i, fig. 3; Regan, 1913, *t.c.*, p. 282.

Depth of body 9 in the length, length of head 3. Snout $1\frac{2}{5}$ as long as eye, diameter of which is $4\frac{1}{2}$ in length of head; interorbital width 14. Lower jaw projecting; maxillary reaching vertical from anterior margin of eye; cheek naked below the suborbitals; a small patch of scales on upper part of operculum; 11 gill-rakers on lower part of anterior arch. About 90 scales in a lateral longitudinal series, about 55 in the lateral line, which is complete. Dorsal 34. Anal 29. Pectoral with 23 rays, as long as head behind middle of eye, extending to above origin of anal; pelvics shorter, not reaching vent. Caudal subtruncate. Brownish; posterior part of caudal, distal parts of pelvics, and margin of anal more or less dusky.

Hab. South-west of Balleny Islands, 460 metres.

Known only from the type of the species, 210 mm. in total length.

Bathydraco scotiae, Dollo.

Bathydraco scotiae, Dollo, 1906, *Proc. R. Soc. Edinburgh*, XXVI, p. 65; Regan, 1913, *t.c.*, p. 282, pl. ix, fig. 4; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 74.

Depth of body 9 to 10 in the length, length of head $3\frac{1}{6}$ to $3\frac{1}{4}$. Snout $1\frac{3}{4}$ as long as eye, diameter of which is about 5 in length of head; interorbital width 12 or 13. Lower jaw projecting; maxillary not reaching vertical from anterior margin of eye; cheek naked below the suborbitals; a small patch of scales on upper part of operculum; 19 to 22 gill-rakers on lower part of anterior arch. About 100 scales in a lateral longitudinal series, 36 to 43 in the lateral line, which ends at a distance from the caudal equal to $\frac{1}{4}$ or $\frac{1}{2}$ its own length. Dorsal 38–40. Anal 30–31. Pectoral with 22 or 23 rays, as long as head without snout, extending to above origin of anal or a little beyond; pelvics shorter, not reaching vent; caudal subtruncate. Pale brownish, the lower parts somewhat darker; caudal, anal, pectorals and pelvics more or less dusky.

Hab. Off Coats Land; off coast between Queen Mary Land and Wilkes Land.

The types of the species, 2 specimens 133 and 145 mm. in total length, were taken by the 'Scotia' off Coats Land (71° 22′ S, 16° 34′ W), at a depth of 2645 metres. The

B.A.N.Z. Antarctic Research Expedition obtained a single specimen, 160 mm. long, from 64° 21′ S, 116° 02′ E, at a depth of 2260 metres.

Bathydraco nudiceps, Waite.

Bathydraco nudiceps, Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 27, pl. i, fig. 3, text-fig. 4.

Depth of body $7\frac{1}{5}$ in the length, length of head 3. Snout a little longer than eye, diameter of which is $3\frac{1}{5}$ in length of head; interorbital width 12. Lower jaw projecting; maxillary extending to below anterior margin of eye; head entirely naked; 17 gill-rakers on lower part of anterior arch. Body covered with cycloid scales; lateral line forming a low arch over the operculum, consisting of 5 or 6 large pores; a series of imperforate depressed scales forms a line from above the pectoral, thence along the middle of the side to the base of the caudal rays. Dorsal 27. Anal 22. Pectoral with 22 rays, extending to above the third anal ray; pelvics about as long, reaching vent. Caudal truncate. Pale brownish, the lower parts darker; dorsal fin pale, all other fins dark.

Hab. Off Queen Mary Land.

The type of the species, 144 mm. in total length, was from off Shackleton Ice-shelf (65° 30′ S, 95° 27′ E), at a depth of 450 metres: the 'Aurora' obtained two other examples in the same neighbourhood at a depth of about 600 metres.

Genus GERLACHEA

Gerlachea, Dollo, 1900, *Bull. Acad. roy. Belg.* (*Classe Sci.*), No. 3, p. 195; 1904, *Rés. Voy. 'Belgica'*, Zool., Poiss., p. 24; Regan, 1913, *t.c.*, p. 283. Type *Gerlachea australis*, Dollo.

Differs from *Bathydraco* in having two lateral lines, the long upper one running near the base of the dorsal fin, the short lower one above the anal fin. Snout narrow, more than twice as long as diameter of eye. Dorsal with 45 to 47 rays; anterior part of fin not elevated; caudal emarginate.

A single species.

Deep water off the coasts of the Antarctic Continent.

Gerlachea australis, Dollo.

Gerlachea australis, Dollo, 1900, *t.c.*, p. 196; 1904, *t.c.*, p. 25, pl. ii, fig. 1, pl. v, fig. 2; Roule and Despax, 1911, *Bull. Mus. Paris*, 1911, No. 5, p. 280; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 10, pl. i, fig. 1, pl. ii, figs. 1–2, pl. iii, fig. 5; Regan, 1913, *t.c.*, p. 283; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 29.

Depth of body $7\frac{1}{2}$ to more than 12 in the length, length of head $3\frac{1}{4}$ to nearly $3\frac{1}{2}$. Snout more than twice as long as eye, diameter of which is $4\frac{1}{5}$ to about $5\frac{1}{5}$ in length of head; interorbital width 11 to 14. Lower jaw projecting; maxillary not nearly reaching anterior margin of eye; cheek scaled; a patch of scales on upper part of operculum; gill-rakers represented by about 8 low dentigerous patches on the first arch. 85 scales in upper lateral line, which extends to below last ray of dorsal fin or a little beyond; length of lower lateral line variable. Dorsal 45–47. Anal 34–35. Pectoral with 26 to 28 rays, $\frac{3}{5}$ to nearly $\frac{4}{5}$ length of head, extending to above vent or anterior rays of anal; pelvics much shorter, not nearly reaching vent. Caudal emarginate, its angles rounded. Yellowish brown; body with dark blotches or irregular cross-bars; a dark line from the snout to the eye, thence obliquely downwards across the opercles; all fins more or less dusky, except the anal, which is pale; distal parts of pelvics black.

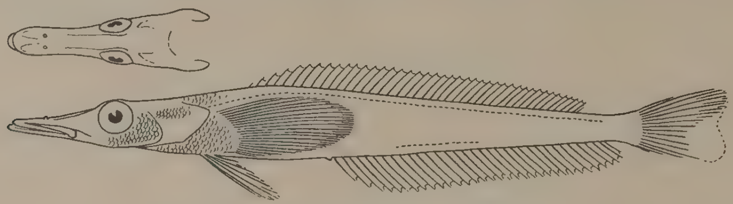

Fig. 34. *Gerlachea australis*. Holotype. × $\frac{2}{3}$.

Hab. Graham Land; Charcot Land; Queen Mary Land: in deep water.

Through the courtesy of Dr V. Van Straelen, I have been able to examine the holotype of this species preserved in the Musée Royal d'Histoire Naturelle de Belgique. This is 180 mm. in total length and is in excellent condition. It was taken by the 'Belgica' at 71° 14′ S, 89° 14′ W, at a depth of 450 metres. The 'Pourquoi Pas?' obtained 4 examples[1] from 70° 10′ S, 80° 50′ W, at a depth of 450 metres, one of which (in a poor state of preservation) has been examined by me in the Paris Museum. The 'Aurora' obtained a single example, 208 mm. in length, from 64° 44′ S, 97° 28′ E, at a depth of 670 metres.

The extent to which the lower lateral line is developed seems to be somewhat variable. In the holotype it appears to be represented by about 18 scales on the left side, whereas, on the right side it is longer and is represented by at least 30 scales. Roule, Angel and Despax remark that in the specimens obtained by the 'Pourquoi Pas?' this lateral line is unequally developed on the two sides of the same fish, and Waite records the same condition in his example.

Three of the specimens taken by the 'Pourquoi Pas?' in January were mature females, and contained large eggs, varying in size from 2·5 to 3 mm.

Genus RACOVITZIA

Racovitzia, Dollo, 1900, *Bull. Acad. roy. Belg.* (*Classe Sci.*), No. 3, p. 317. Type *Racovitzia glacialis*, Dollo.

Racovitzaia, Dollo, 1904, *Rés. Voy. 'Belgica'*, Zool., Poiss., p. 28; Regan, 1913, *t.c.*, p. 283 [*emend. pro Racovitzia*].

Aconichthys, Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 30. Type *Aconichthys harrissoni*, Waite.

Related to *Bathydraco*, but with three lateral lines (except in the young), the upper always present and running near the base of the dorsal fin, the short middle one on the side of the caudal peduncle, and the short lower one above the base of the posterior part of the anal fin. Snout rather broad, spatulate, not more than $1\frac{1}{2}$ times as long as the eye. Dorsal with 30 to 37 rays, the anterior part of the fin forming a fairly distinct lobe; caudal rounded or subtruncate.

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[1] One of these specimens has now been received in exchange from the Paris Museum: this is also in a very poor state of preservation.

One or two species.

Coasts of Antarctic Continent.

Comparison of the unique type specimen of *Racovitzia glacialis*[1] with examples of *Aconichthys harrissoni* shows that the two fishes are almost certainly congeneric and may eventually prove to be identical. The body of *Racovitzia* was described by Dollo as having scattered groups of scales, but this character seems to be due to damage to the fish in capture. A specimen of *Aconichthys* (98 mm. in total length) shows a very similar condition, but a close examination of the skin reveals that many of the scales have become detached, leaving isolated groups on various parts of the body. In the type of *Racovitzia* only the upper lateral line is present, and this runs near the base of the dorsal fin. In a specimen of *Aconichthys*, 80 mm. in total length, the same condition is found, and the single lateral line ends below the posterior rays of the dorsal fin. In the specimen of 98 mm. mentioned above, this upper line extends a little beyond the end of the dorsal fin, and there is an indication of the middle line on the side of the caudal peduncle; there is, however, no trace of a lower lateral line. In all the larger examples of *Aconichthys* examined by me three lines are present, although in one example of 195 mm. on one side of the body the lower line is reduced to 2 or 3 scales, and in another of about the same size this line is present on one side of the body but entirely wanting on the other. I am unable to confirm the presence of the "incubatory pouch" between the pelvic fins and the vent described by Dollo, but am inclined to think that a post-mortem shrinkage in this region accompanied by folding of the skin may have produced the pouch-like condition.

Racovitzia glacialis, Dollo.

Racovitzia glacialis, Dollo, 1900, *t.c.*, p. 318.
Racovitzaia glacialis, Dollo, 1904, *t.c.*, p. 29, pl. ii, figs. 2, 3, pl. v, fig. 3; Regan, 1913, *t.c.*, p. 283.

Depth of body 12 in the length, length of head $3\frac{1}{4}$. Snout longer than eye, about $2\frac{3}{4}$ in length of head; diameter of eye about $3\frac{3}{4}$, interorbital width 25. Lower jaw slightly projecting; maxillary not reaching vertical from anterior margin of eye. Dorsal 30. Anal 27. Pectoral with 25 rays, about $\frac{2}{3}$ length of head, extending as far as vent; pelvics shorter, not reaching vent. Body with dark spots and blotches forming very irregular cross-bars; an irregular black spot on anterior part of dorsal; anal pale; a black spot on upper edge of caudal; pectorals blackish at the base and with a black spot on upper edge; pelvics with a black spot distally.

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[1] This specimen, which is 82 mm. in total length, is in very poor condition, the caudal fin being largely wanting and a portion of the caudal region of the body broken off. It is very difficult to handle the specimen or to make any close examination of it, for fear of causing further damage.

Hab. 71° 19′ S, 87° 37′ W; 435 metres.

Known only from the unique holotype, 82 mm. in total length, in the Musée Royal d'Histoire Naturelle de Belgique, Brussels. As pointed out above, I have re-examined this specimen, but, owing to the poor state of preservation, have been able to add very little to the original description.

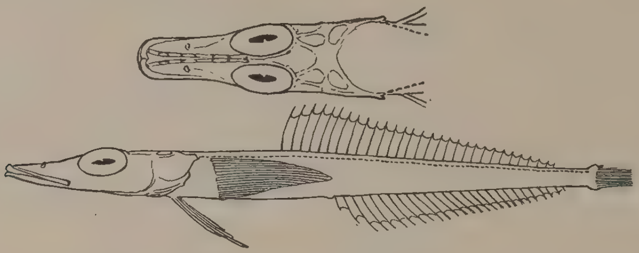

Fig. 35. *Racovitzia glacialis*. Holotype. × 1. (After Dollo.)

Racovitzia harrissoni (Waite).

> *Aconichthys harrissoni*, Waite, 1916, *t.c.*, p. 30, pl. ii, fig. 1, text-fig. 5; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, 1, p. 74.

St. 600. 17. i. 31. 67° 09′ S, 69° 27′ W. Large dredge, 487–512 m.: 1 specimen, 80 mm.

St. 1652. 23. i. 36. 75° 56·2′ S, 178° 35·5′ E. Rectangular dredge, with Russell net, 567 m.: 1 specimen, 293 mm.

Depth of body $7\frac{1}{2}$ to $9\frac{1}{2}$ in the length, length of head 3 to $3\frac{1}{3}$. Snout $1\frac{1}{3}$ to $1\frac{1}{2}$ times as long as eye, 3 to $3\frac{1}{5}$ in length of head; diameter of eye $3\frac{3}{4}$ to $4\frac{1}{4}$ in length of head; interorbital region very narrow. Lower jaw projecting; maxillary extending to or nearly to level of anterior margin of eye; a large patch of scales on the cheek and a small patch on upper part of operculum; 10 to 12 short gill-rakers on lower part of anterior arch. About 140 scales in a lateral longitudinal series; 82 to 91 in upper, 9 to 13 in middle, and 5 to 13 in lower lateral line (when this is present). Dorsal 34–37. Anal 28–31. Pectoral with 22 or 23 rays, about $\frac{3}{4}$ length of head, extending to above origin or anterior rays of anal; pelvics much shorter, not nearly reaching vent. Caudal rounded or subtruncate. Pale yellowish brown, spotted and variegated with darker; 6 black blotches on the back, the 4 below the dorsal fin most conspicuous and extending on to the fin; lower parts more or less dusky; dorsal fin with small dark spots on the rays, and sometimes with a dark blotch covering the posterior rays; anal fin pale or with a dusky longitudinal submarginal band, and with a white margin; caudal with its distal part dusky and its upper and lower edges black; always a distinct black spot on proximal part of upper edge; sometimes a narrow white posterior edge to the fin; pectoral usually with cross-bars; pelvics more or less dusky.

Hab. Off Graham Land; Mac-Robertson Land; Queen Mary Land; South Victoria Land.

This species was originally described from 5 specimens taken off Queen Mary Land at depths varying from 450 to 610 metres. The holotype was 278 mm. in total length.

In addition to the 2 specimens listed above, the description includes 4 examples (98 to 195 mm.) obtained by the B.A.N.Z. Antarctic Research Expedition.

It seems possible that this species will prove to be identical with *R. glacialis*, but, as described by Dollo, the latter has fewer dorsal and anal rays, a more slender body, and a rather longer snout. It may be noticed that the intense black spot on the upper edge of the caudal fin characteristic of this species is shown by Dollo in his figure of the type of *R. glacialis*.

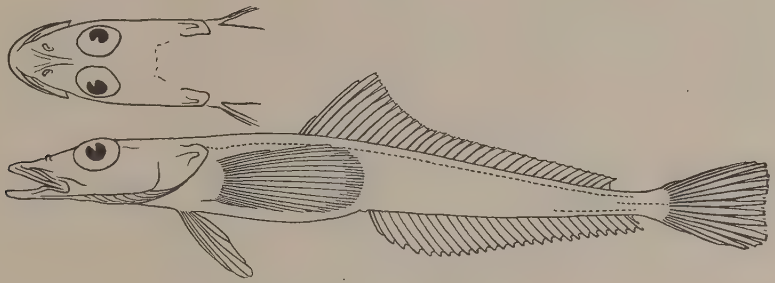

Fig. 36. *Racovitzia harrissoni*. × $\frac{2}{5}$.

Genus PRIONODRACO

Prionodraco, Regan, 1914, *Ann. Mag. Nat. Hist.*, (8) XIII, p. 13; 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. I (1), p. 10. Type *Prionodraco evansii*, Regan.

Body elongate, compressed, quadrangular, with a series of V-shaped, serrated, bony plates at each angle; each plate with a backwardly directed spine; lower series of plates ending in a group of nearly normal serrated scales behind pectoral fin; usually a series of similar scales along middle of side; body otherwise naked. Lateral line single, incomplete. Snout spatulate; mouth slightly protractile; teeth small, villiform, in bands. Operculum hooked upwards posteriorly, its upper edge deeply concave; gill-membranes narrowly united to the isthmus anteriorly. Vertebrae 50 (16+34).

A single species.

Coasts of the Antarctic Continent.

Prionodraco evansii, Regan.

Prionodraco evansii, Regan, 1914, *t.c.*, p. 13; 1914, *t.c.*, p. 10, pl. vii, fig. 1; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 35; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 75.

St. 167. 20. ii. 27. Off Signy Island, South Orkneys. Net (7 mm. mesh) attached to back of trawl, 244–344 m.: 30 specimens, 65–162 mm.

Depth of body 7 to 8 in the length, length of head 3 to $3\frac{2}{3}$. Snout as long as or a little longer than eye, diameter of which is 3 to $3\frac{1}{2}$ in length of head; interorbital width 14 to 16. Lower jaw a little projecting; maxillary extending to or nearly to level of anterior margin of eye; cheeks and opercles entirely naked; 15 to 18 gill-rakers on lower part of anterior arch. About 50 plates in the upper series; 12 to 17 tubular scales in lateral line, which ends below anterior part of dorsal fin. Dorsal 34–38. Anal 29–33. Pectoral with 21 or 22 rays, $\frac{2}{3}$ to $\frac{3}{4}$ length of head, extending to above anterior rays of anal; pelvics shorter, not reaching vent. Caudal rounded or subtruncate. Head and body with numerous dark spots; usually a well-defined lateral series of large oblong or squarish spots; a deep black spot on base of anterior part of dorsal fin and sometimes 2 or 3 smaller spots more posteriorly; some small spots on the rays of the dorsal fin; caudal and pectorals with spots or irregular cross-bars; anal generally with a dark longitudinal band along its margin, becoming narrower posteriorly, the rays tipped with white; pelvics pale or more or less dusky.

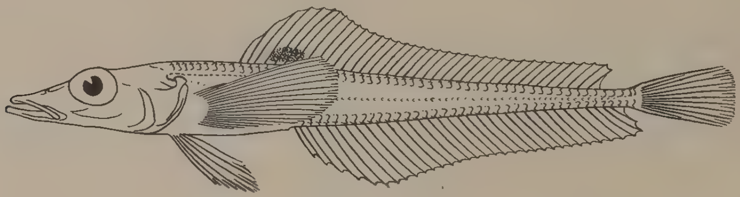

Fig. 37. *Prionodraco evansii*. × $\frac{3}{4}$.

Hab. South Orkneys; Mac-Robertson Land; Queen Mary Land; South Victoria Land.

The types of the species, 11 specimens, measuring up to 132 mm. in total length, are from the Ross Sea (74° 25′ S, 179° 3′ E), 290 metres; and the entrance to McMurdo Sound (76° 56′ S, 164° 12′ E and 77° 13′ S, 164° 18′ E), 300 and 380 metres. In addition to the types and the examples obtained by the Discovery Committee, the above description includes a number of specimens, up to 145 mm. in total length, collected by the B.A.N.Z. Antarctic Research Expedition.

Genus **CYGNODRACO**

Cygnodraco, Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 32. Type *Cygnodraco mawsoni*, Waite.

Body elongate, compressed, naked; two lateral lines, the upper terminating below posterior part of dorsal fin, the lower represented by a broken series of depressed, non-perforate scales, running along middle of hinder part of body. Head scarcely depressed; snout produced, spatulate; interorbital region narrow; jaws with bands of small, villiform teeth. Operculum with upper edge concave, armed with divergent ridges ending in spinous points; gill-rakers represented by very small, flat, dentigerous knobs; gill-membranes free from the isthmus but slightly united anteriorly. Dorsal with 61 to 66 rays; anal with 35 to 38 rays. Pelvics rather long and narrow, as long as or longer than the pectorals.

A single species.

Coasts of the Antarctic Continent.

Cygnodraco mawsoni, Waite.

Cygnodraco mawsoni, Waite, 1916, *t.c.*, p. 33, pl. iii, fig. 1, text-fig. 6; Norman, 1937, *t.c.*, p. 75.

Depth of body $7\frac{3}{4}$ to nearly 10 in the length, length of head $2\frac{3}{4}$ to 3. Snout nearly $\frac{1}{2}$ length of head; diameter of eye $5\frac{1}{4}$ (young) to nearly 6, interorbital width 31 to 33 in length of head. Lower jaw a little projecting; maxillary not nearly reaching vertical from anterior margin of eye; 14 or 15 gill-rakers on lower part of anterior arch. About 110 scales in the upper lateral line, which follows the dorsal profile. Dorsal 61–66. Anal 35–38. Pectoral with 22 or 23 rays, length 2 to $2\frac{1}{3}$ in that of head, not nearly reaching vent; pelvics as long as or longer than pectorals (much longer in young), not reaching vent. Caudal rounded. Yellowish or greyish-brown; traces of a dark line on each side of the snout, a dark spot below the eye, and a dark bar running backwards from the eye towards the suboperculum; body with about 7 rather indistinct dark cross-bars on the back and upper parts of the sides; dorsal, anal and caudal more or less dusky, at least in adults, the dorsal with two narrow longitudinal dark stripes running for the whole length of the fin; pectorals and pelvics pale.

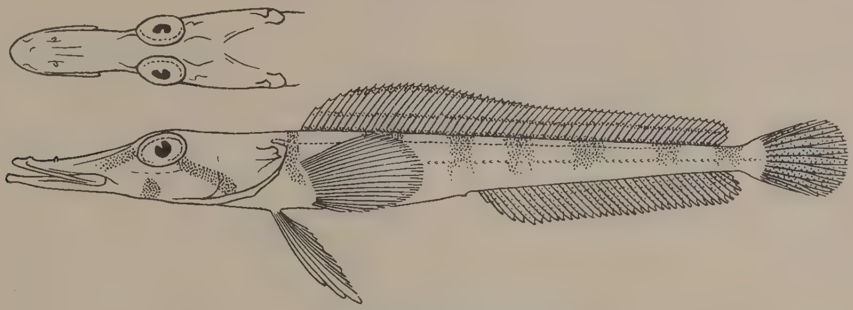

Fig. 38. *Cygnodraco mawsoni*. $\times\frac{1}{3}$.

Hab. Mac-Robertson Land; Queen Mary Land.

The type of the species, 466 mm. in total length, was taken off Drygalski Island (65° 42′ S, 92° 10′ E), at a depth of 112 metres. The above description is based mainly upon 6 specimens, 125 to 360 mm. in total length, obtained by the B.A.N.Z. Antarctic Research Expedition, at a depth of 219 metres.

Genus PARACHAENICHTHYS

Parachaenichthys, Boulenger, 1902, *Rep. Coll. Nat. Hist. 'Southern Cross'*, p. 176. Type *Chaenichthys georgianus*, Fischer.

Very closely related to *Cygnodraco*, but with the head and anterior part of the body more or less depressed and the interorbital region broader. The upper lateral line extends beyond the end of the dorsal fin. Dorsal with 42 to 46 rays; anal with 30 to 33 rays. Pelvics broader, generally a little shorter than pectorals.

Two species.

Graham Land and neighbouring islands; South Georgia.

Parachaenichthys georgianus (Fischer).

Chaenichthys georgianus, Fischer, 1885, *Jahrb. Hamburg. Wiss. Anst.*, II, p. 50, pl. i, figs. 1–2.
Parachaenichthys georgianus, Boulenger, 1902, *t.c.*, p. 176; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 36; 1906, *K. Svensk. Vet.-Akad. Handl.*, XL (5), p. 95; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 287.

St. MS 32. 1. v. 25. East Cumberland Bay, South Georgia. Small beam trawl, 40 m.: 2 specimens, 84, 185 mm.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 8 specimens, 260–470 mm.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: 2 specimens, 83, 92 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 270–238 m.: 4 specimens, 280–480 mm.; large otter trawl, 238–270 m.: 1 specimen, 82 mm.

St. 140. 23. xii. 26. Stromness Harbour to Larsen Point, South Georgia. Large otter trawl, 122–136 m.: 1 specimen, 160 mm.

St. —. 6. i. 27. Stromness Harbour, South Georgia. Hand line, 9–10 m.: 1 specimen, 455 mm.

St. 148. 9. i. 27. Off Cape Saunders, South Georgia. Larger otter trawl, 132–148 m.: 1 specimen, 170 mm.

St. 149. 10. i. 27. Mouth of East Cumberland Bay, South Georgia. Large otter trawl, 200–234 m.: 4 specimens, 175–435 mm.

St. WS 62. 19. i. 27. Wilson Harbour, South Georgia. Small beam trawl, 26–83 m.: 11 specimens, 65–115 mm.

St. WS 65. 22. i. 27. Undine Harbour (North), South Georgia. Hand line, 5 m.: 2 specimens, 450, 475 mm.

St. —. Nov. 1930. 1 specimen, 133 mm., taken from stomach of *Chaenocephalus aceratus*.

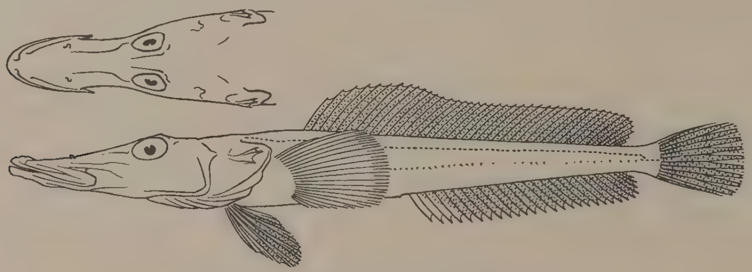

Fig. 39. *Parachaenichthys georgianus*. × $\frac{1}{2}$.

Depth of body 7 to 10 in the length, length of head $2\frac{1}{2}$ to nearly 3. Snout nearly $\frac{1}{2}$ length of head; diameter of eye 5 (young) to $7\frac{1}{2}$, interorbital width 13 to 17 in length of head. Lower jaw a little projecting; maxillary not nearly reaching vertical from anterior margin of eye; operculum with 3 radiating ridges terminating in spinous points; 16 to 19 gill-rakers on lower part of anterior arch. 102 to 110 tubular scales in upper lateral line, which extends beyond last ray of dorsal fin and joins the lower lateral line on the caudal peduncle; this part of the lower lateral line with 4 to 9 tubular scales, in front of which is an irregular series of depressed non-perforate scales. Dorsal 43–46. Anal 31–33. Pectoral with 21 to 23 rays, length 2 to $2\frac{1}{3}$ in that of head, not or scarcely reaching vent; pelvics a little shorter, not reaching vent in adult. Caudal rounded or subtruncate. Yellowish-brown, spotted and variegated with darker, the markings being more distinct in young and half-grown specimens; dorsal pale in young, with series of spots on the rays forming two longitudinal dark stripes, becoming more or less dusky posteriorly; in half-grown and adult specimens the whole dorsal fin is dusky, with a narrow white margin; anal pale anteriorly, dusky posteriorly (young), or wholly dusky or blackish, the rays sometimes tipped with white (adult); caudal dusky or blackish; pectorals pale; pelvics blackish on the membrane between the inner rays.

Hab. South Georgia.

This species was described by Fischer from a specimen 490 mm. in total length. He mentions 2 whole specimens and 4 heads in the Zoological Museum at Hamburg (Nos. 3916, 3855).

Parachaenichthys charcoti (Vaillant).

Chaenichthys charcoti, Vaillant, 1906, *Bull. Mus. Paris*, 1906, No. 5, p. 247; 1906, *Expéd. Antarct. Franç.* (1903–1905), Poiss., p. 39, text-fig. 1.

St. 1873. 13. xi. 36. 61° 20·8′ S, 54° 04·2′ W. Rectangular dredge, with Russell net, 200–137 m.: 1 specimen, 290 mm.

Close to the preceding species, but with a somewhat shorter snout, and the interorbital width about 11½ in length of head. Maxillary extending to or nearly to level of anterior margin of eye; operculum with 5 or 6 radiating ridges ending in spinous points, the uppermost with an antrorse hook; 13 gill-rakers on lower part of anterior arch. 114 tubular scales in upper lateral line; no tubular scales in lower lateral line, which is represented by a series of depressed, non-perforate scales running along middle of hinder part of body. Dorsal 42. Anal 30. Pectoral with about 21 rays. Yellowish-brown; head and anterior part of body with numerous small dark spots and rings; hinder part of body with incomplete and irregular dark cross-bars; dorsal and anal plain, the latter with a pale margin; caudal blackish, with a narrow pale hinder edge; small dark spots at bases of pectorals; pelvics dusky.

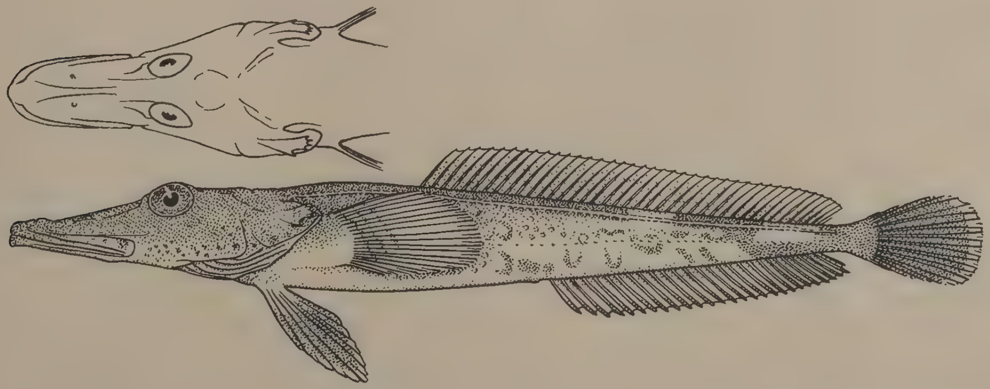

Fig. 40. *Parachaenichthys charcoti*. × ½.

Hab. Graham Land and neighbouring islands.

The type of this species consists of a head, 145 mm. in length (measured to tips of opercular spines), and a portion of the tail-end of the body, the latter very poorly preserved, in the Paris Museum (No. 06—144). As the jaws and opercles of this specimen are fully expanded, as shown in Vaillant's figure, the general appearance of the head appears at first sight unlike that of a *Parachaenichthys*. I have carefully examined the type, however, and have little doubt that it belongs to the same species as the much smaller fish obtained by the 'Discovery II'. The type is from Booth Wandel Island, at a depth of 30 metres.

Genus **PSILODRACO**

Psilodraco, Norman, 1937, *Ann. Mag. Nat. Hist.*, (10) xx, p. 475. Type *Psilodraco breviceps*, Norman.

Body naked, subcylindrical anteriorly, compressed posteriorly; three lateral lines, consisting of series of imperforate scales more or less embedded in the skin. Head not much depressed; snout not produced, bluntly pointed; mouth moderately protractile; a band of villiform teeth in the upper jaw; each praemaxillary with a group of canine teeth anteriorly; teeth in lower jaw in several rows anteriorly, becoming uniserial laterally. Gill-membranes forming a fold across the isthmus; 6 branchiostegals; gill-rakers reduced to a few vestiges near the angles of the arches; operculum with a fairly strong spine with a hooked branch; suboperculum without spine. No spinous dorsal fin. Pelvic fins short, with the middle rays longest. Vertebrae 48 (16+32).

A single species.

South Georgia.

This genus is clearly related to *Gymnodraco*, and examination of a skeleton prepared for me by Mr W. R. Sherrin reveals no important osteological differences. *Psilodraco* differs from *Gymnodraco* mainly in the shape of the head and body, the form of the jaws and teeth, and in the presence of three lateral lines.

Psilodraco breviceps, Norman.

Psilodraco breviceps, Norman, 1937, *t.c.*, p. 476.

St. MS 68. 2. iii. 26. East Cumberland Bay, South Georgia. Large rectangular net, 220–247 m.: 1 specimen, 128 mm.

St. MS 71. 9. iii. 26. East Cumberland Bay, South Georgia. Small beam trawl, 110–60 m.: 1 specimen, 36 mm.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 22 specimens, 36–195 mm. (holotype, 190 mm.).

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: 12 specimens, 48–137 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 238–270 m.: 22 specimens, 90–180 mm.

St. 123. 15. xii. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 230–250 m.: 6 specimens, 70–115 mm.

St. 142. 30. xii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 88–273 m.: 3 specimens, 137–185 mm.

St. 149. 10. i. 27. Mouth of East Cumberland Bay, South Georgia. Large otter trawl, 200–234 m.: 2 specimens, 123, 145 mm.

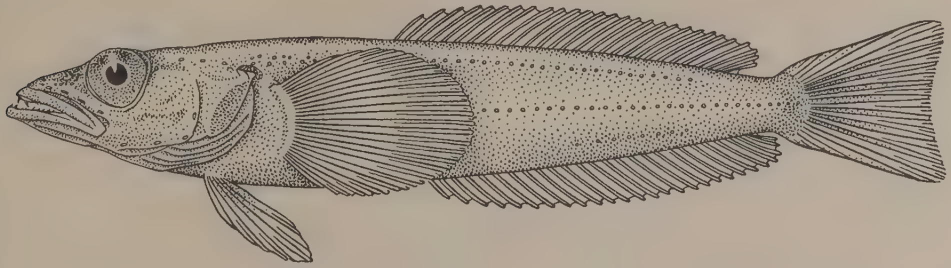

Fig. 41. *Psilodraco breviceps*. Holotype. × $\frac{3}{4}$.

Depth of body $4\frac{3}{4}$ to $5\frac{1}{2}$ in the length, length of head about 3. Snout about as long as eye, diameter of which is 3 to nearly 4 in length of head; interorbital width 8. Lower jaw projecting; maxillary extending to below anterior $\frac{1}{2}$ or middle of eye. Upper lateral line extending to below last rays of dorsal or not as far; middle lateral line extending forward to level of middle or posterior part of pectoral; lower lateral line of varying length, running parallel with the base of the anal fin. Dorsal 27–30. Anal 27–29. Pectoral with 25 to 27 rays, nearly as long as head, extending to above anterior part of anal; pelvics much shorter, not reaching vent. Brownish above, more or less silvery on sides and beneath, without any definite markings, but with the silvery parts speckled with close-set dark dots; distal part of snout and tip of lower jaw usually darker; fins usually all pale, the caudal and occasionally the other fins sometimes a little dusky.

Hab. South Georgia.

Genus GYMNODRACO

Gymnodraco, Boulenger, 1902, *Rep. Coll. Nat. Hist. 'Southern Cross'*, p. 186; Regan, 1913, *t.c.*, p. 283.

Related to *Psilodraco*, but with the body depressed anteriorly, compressed posteriorly. Two lateral lines. Head depressed; snout produced, pointed; mouth non-protractile; jaws with curved compressed teeth, close-set in a single series and with large anterior canines, those of the mandible exposed in front of the snout. Operculum with a strong spine with a hooked branch; suboperculum with a short spine. Vertebrae 48 (20+28).

A single species.

Coasts of the Antarctic Continent.

Gymnodraco acuticeps, Boulenger.

Gymnodraco acuticeps, Boulenger, 1902, *t.c.*, p. 186, pl. xvii; Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. v, p. 176, pl. ix, fig. 4; Regan, 1913, *t.c.*, p. 284.

Depth of body 8 in the length, length of head about 3. Snout as long as postorbital part of head; diameter of eye 5 to 6 in length of head, interorbital width 6 to 7. Lower jaw strongly projecting; maxillary extending to below anterior margin of eye. Upper lateral line extending from the gill-opening to about the vertical of the origin of the dorsal, lower lateral line from below the extremity of the upper to the base of the caudal fin, running along the middle of the caudal region. Dorsal 28–30. Anal (22) 24–26. Pectoral with 21 or 22 rays, truncated, $\frac{1}{2}$ as long as head; pelvics much shorter, not nearly reaching vent. Caudal truncate. Brownish-olive, the lower parts whitish; large dark spots on head and body; fins dusky.

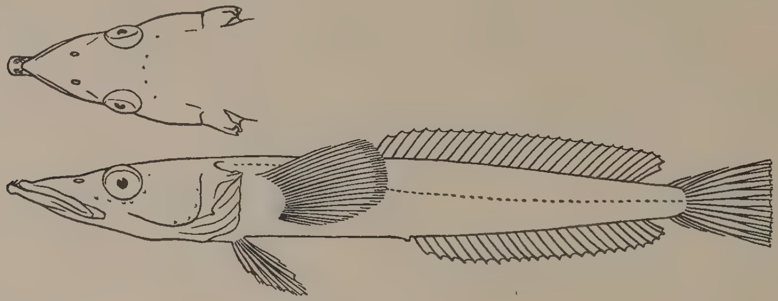

Fig. 42. *Gymnodraco acuticeps*. × $\frac{1}{2}$.

Hab. Wilhelm Land; South Victoria Land.

The types of the species, 5 specimens up to 300 mm. in total length, are from Cape Adare, 7 to 14 metres: two of these (200 and 300 mm.) are in the collection of the British Museum. The 'Gauss' obtained a further example, 200 mm. long, from the Winter Quarters of the expedition in Wilhelm Land.

Family CHAENICHTHYIDAE

Body naked. Snout produced and depressed, spatulate. Mouth non-protractile; palatine in great part ligamentous; pterygoid slender; no mesopterygoid. Gill-membranes very narrowly united to isthmus or forming a fold across it; operculum usually with radiating ridges ending in simple or branched spines. Spinous dorsal fin present. Ribs not ossified.

Nine genera, all of which occur in, and eight of which are confined to, the Antarctic Zone.

Key to the Genera

I. Middle rays of pelvic fin longest.
    A. Lateral line without bony plates.
        1. Spinous dorsal of 8 to 15 spines; operculum with at least 3 spines.
            a. Two lateral lines (upper and middle); dorsal fins subcontinuous.
                α. Dorsal IX–X, 32–40; anal 31–39; no rostral spine; gill-rakers short, but well-developed ... ... 1. *CHAMPSOCEPHALUS.*
                β. Dorsal (IX) XII–XV, 26–31; anal 24–27; a rostral spine; gill-rakers vestigial or absent ... ... 2. *PAGETOPSIS.*

b. Three lateral lines; dorsal fins well separated; dorsal VIII–X, 29–31; anal 28–31; gill-rakers short, but well-developed ... 3. *PSEUDOCHAENICHTHYS.*

2. Spinous dorsal of 3 spines; operculum with a single broad, flat spine; two lateral lines (upper and lower) ... ... 4. *DACODRACO.*

B. Lateral line with bony plates; a rostral spine; dorsal VII–VIII, 30–34; anal 28–33; dorsal fins separated by an interspace; two lateral lines (upper and middle). 5. *CHAENICHTHYS.*

II. Two outer soft rays of pelvic fin longest.

A. Sub- and inter-operculum not spinate; rostral spine reduced or absent.

1. Pelvic fins comparatively short, with the rays branched or bifid (except in young); spinous dorsal of 7 or 8 spines, separated from soft dorsal by a short interspace; two lateral lines ... ... 6. *CHAENOCEPHALUS.*

2. Pelvic fins long, with the rays simple; spinous dorsal of 3 to 5 spines, separated from soft dorsal by a long interspace; three lateral lines ... ... 7. *CRYODRACO.*

B. Sub- and inter-operculum bearing a pair of spines behind angle of praeoperculum; rostral spine well-developed; three lateral lines.

1. Pelvics I 5; gill-rakers reduced to a few vestiges near the angles of the arches. 8. *CHIONODRACO.*

2. Pelvics I 4; gill-rakers developed as dentigerous knobs or patches 9. *CHAENODRACO.*

Genus **CHAMPSOCEPHALUS**

Champsocephalus, Gill, 1862, *Proc. Acad. N.S. Philad.*, (1861), p. 509; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 285. Type *Chaenichthys esox*, Günther.

Body naked, elongate; two lateral lines (upper and middle), without bony plates. No rostral spine; eye nearly in middle of length of head. Jaws with rather narrow bands of small, sharp teeth, forming only two series laterally; lower jaw not projecting. Gill-rakers short, but well developed on all the branchial arches, dentigerous; operculum with 3 radiating ridges terminating in spinous points. Spinous dorsal well developed, its base less than $\frac{1}{3}$ that of the soft dorsal, with which it is almost continuous; pelvics comparatively short, with the rays normally branched, the middle ones the longest.

Two species, of which one occurs in the Antarctic Zone.

Patagonian Region; South Georgia; Kerguelen.

Champsocephalus gunnari, Lönnberg.

Champsocephalus gunnari, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 37; 1906, *K. Svensk. Vet.-Akad. Handl.*, XL (5), p. 96; Regan, 1913, *t.c.*, p. 285, pl. x, fig. 2; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 65.

St. 39. 25. iii. 26. Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 14 specimens, 235–275 mm.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: 2 specimens, 250, 325 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 270–238 m.: 2 specimens, 205, 258 mm.

St. 123. 15. xii. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 230–250 m.: 5 specimens, 220–270 mm.

St. 140. Stromness Harbour to Larsen Point, South Georgia. Large otter trawl, 122–136 m.: 1 specimen, 155 mm.

Depth of body 6 to $7\frac{1}{5}$ in the length, length of head $3\frac{1}{5}$ to $3\frac{1}{2}$. Snout about as long as postorbital part of head; diameter of eye $4\frac{1}{5}$ to $5\frac{1}{3}$, interorbital width $3\frac{1}{2}$ to $4\frac{1}{2}$ in length of head. Maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{3}$ of eye; upper and middle opercular spines only free distally, appearing as a single bifid (sometimes trifid) spine. Dorsal IX–X, 37–40. Anal 36–39. Pectoral with 25 to 27 rays, about $\frac{3}{4}$ length of head, extending to above anterior rays of anal; pelvics about $\frac{3}{5}$ length of head. Yellowish-brown or plumbeous, with a series of darker cross-bars; dorsal and anal fins usually more or less blackish; other fins pale or dusky.

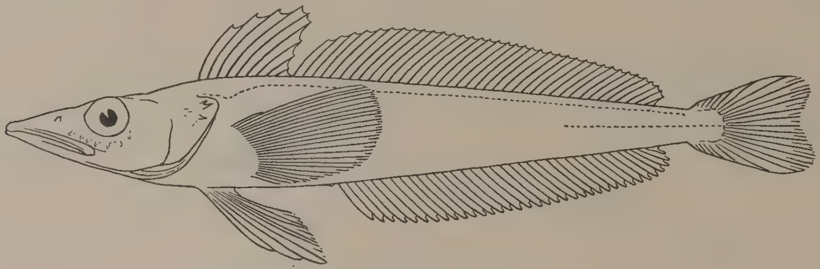

Fig. 43. *Champsocephalus gunnari*. × $\frac{1}{2}$.

Hab. South Georgia; Kerguelen.

This species was originally described from 9 specimens, 322 to 436 mm. in total length, all from Cumberland Bay, South Georgia, 75 to 195 metres. *C. gunnari* may be readily distinguished from the Patagonian *C. esox* by the deeper body, rather shorter head, larger eye, shorter maxillary, form of the opercular spines; and higher number of dorsal and anal rays, as well as by the difference in coloration. Recently, the B.A.N.Z. Antarctic Research Expedition obtained 2 examples (235 and 300 mm.) of this species from Kerguelen at a depth of 91 metres, as well as remains of other specimens from the stomachs of fishes and penguins.

Genus **PAGETOPSIS**

Pagetopsis, Regan, 1913, *t.c.*, p. 286. Type *Champsocephalus macropterus*, Boulenger.

Body naked, moderately elongate; two lateral lines, without bony plates. An antrorse curved rostral spine; eye behind middle of length of head. Teeth in jaws small, sharp, biserial; lower jaw slightly projecting; gill-rakers vestigial or absent; operculum armed with 3 or 4 radiating ridges terminating in spinous points, the uppermost with an antrorse hook. Spinous dorsal well developed, its base more than $\frac{1}{2}$ that of soft dorsal; pelvics rather long, the rays bifid or slightly branched.

A single species.

Coasts of Antarctic Continent.

Pagetopsis macropterus (Boulenger).

Champsocephalus macropterus, Boulenger, 1907, *Nat. Antarct. Exped. Nat. Hist.*, II, Fish., p. 3, pl. ii; Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. v, p. 174; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 13.

Pagetopsis macropterus, Regan, 1913, *t.c.*, p. 286; 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. I (1), p. 11; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 37, fig. 8; Norman, 1937, *t.c.*, p. 76.

St. 1660. 27. i. 36. 74° 46·4′ S, 178° 23·4′ E. Large otter trawl, 351 m.: 3 specimens, 185–235 mm.

Depth of body 4 to 5$\frac{3}{5}$ in the length, length of head 2$\frac{3}{5}$ to 2$\frac{4}{5}$. Snout nearly $\frac{1}{2}$ length of head; diameter of eye about 5, interorbital width 4 to more than 4$\frac{1}{2}$ in length of head. Maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{3}$ of eye. Dorsal (IX) XII–XV, (26) 27–31. Anal 24–27. Pectoral with 22 or 23 rays, $\frac{1}{2}$ to $\frac{3}{5}$ length of head, extending to above vent or origin of anal; pelvics a little longer, reaching vent or not quite as far. Caudal subtruncate or a little rounded. Dark spots and vermiculations on head; irregular double cross-bars on body; spinous dorsal more or less blackish, the spines tipped with white; soft dorsal dusky; anal and caudal mostly pale; pectorals pale; pelvics blackish.

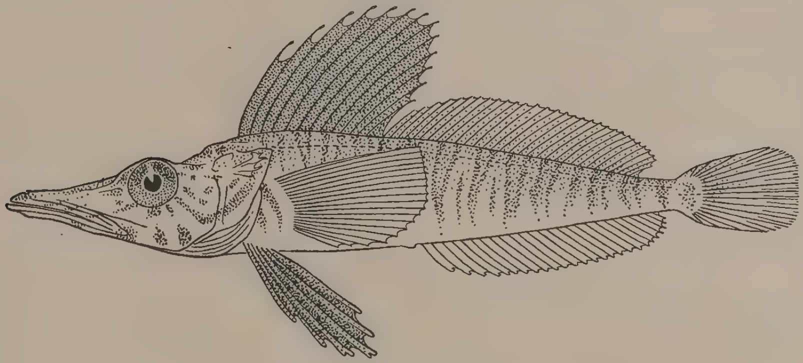

Fig. 44. *Pagetopsis macropterus*. ×$\frac{1}{2}$.

Hab. Graham Land; Enderby Land; Mac-Robertson Land; Wilhelm Land; Queen Mary Land; Adelie Land; South Victoria Land.

This species was originally described from 11 specimens, 65 to 240 mm. long, obtained from the stomach of a Weddell Seal near Cape Armitage, Ross Island: of these, 6 examples (160 to 250 mm.) are in the collection of the British Museum.

Genus PSEUDOCHAENICHTHYS

Pseudochaenichthys, Norman, 1937, *Ann. Mag. Nat. Hist.*, (10) XX, p. 476. Type *Pseudochaenichthys georgianus*, Norman.

Body naked, moderately elongate; three lateral lines, without bony plates. An antrorse curved rostral spine; eye a little behind middle of length of head. Jaws with bands of small, curved, sharp teeth; lower jaw projecting; gill-rakers very short, knob-like, dentigerous; operculum with a group of 4 or 5 spines, the uppermost with an antrorse hook. Spinous dorsal well developed, its base not more than ½ that of soft dorsal, from which it is separated by an interspace; pelvics rather long, with the rays normally branched, the middle ones the longest.

A single species.

South Georgia.

Pseudochaenichthys georgianus, Norman.

Pseudochaenichthys georgianus, Norman, 1937, *t.c.*, p. 476.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 2 specimens, 285, 350 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 270–238 m.: 4 specimens, 350–480 mm. (holotype, 480 mm.).

St. 123. 15. xii. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 230–250 m.: 6 specimens, 155–175 mm.

St. 142. 30. xii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 88–273 m.: 1 specimen, 153 mm.

St. 148. 9. i. 27. Off Cape Saunders, South Georgia. Large otter trawl, 132–148 m.: 3 specimens, 430–465 mm.

Depth of body 4½ to nearly 6 in the length, length of head 2⅓ to 2½. Snout nearly ½ length of head; diameter of eye 5 (young) to 7, interorbital width rather more than 4 in length of head. Supraorbital edges roughened (except in young), but only slightly raised; upper surface of head not rugose; maxillary extending to below middle of eye; about 18 gill-rakers on lower part of anterior arch. Dorsal VIII–X, 29–31; sixth or seventh spine longest. Anal 28–31. Pectoral with 23 or 24 rays, ½ to ⅗ length of head, extending to above origin or anterior rays of anal; pelvics as long as or rather longer than pectorals. Caudal subtruncate or a little rounded. Brownish, the upper parts of the body irregularly marked with darker in the young, but these markings tend to disappear in the adults, which are nearly uniformly coloured; spinous dorsal and pelvics blackish; other fins pale or a little dusky.

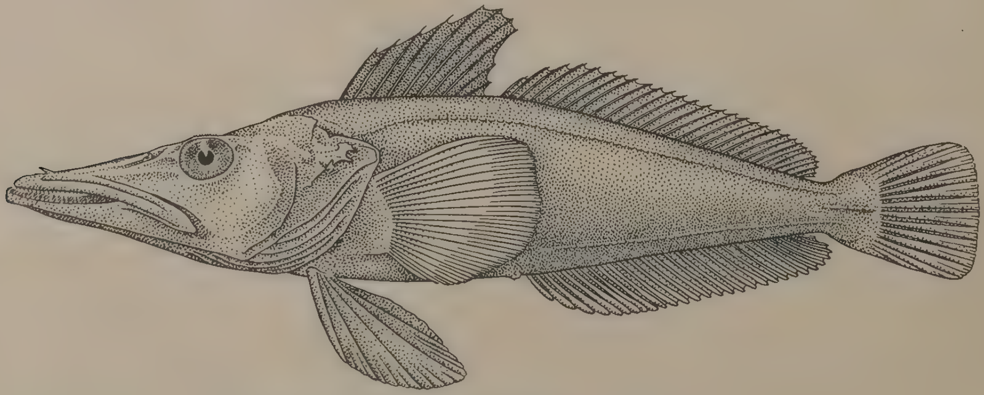

Fig. 45. *Pseudochaenichthys georgianus*. Holotype. ×⅓.

Hab. South Georgia.

Genus DACODRACO

Dacodraco, Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 35. Type *Dacodraco hunteri*, Waite.

Body naked, moderately elongate; two lateral lines (an upper and a lower), without bony plates. No rostral spine; eye behind middle of length of head. Jaws each with a single row of small teeth, with an inner series of large spaced canines; lower jaw slightly projecting; no gill-rakers; operculum with a single broad, flat spine. Spinous dorsal with only 3 spines, well separated from soft dorsal; pelvics of moderate length, with the rays normally branched, the middle ones the longest.

A single species.

Coasts of the Antarctic Continent.

Dacodraco hunteri, Waite.

Dacodraco hunteri, Waite, 1916, *t.c.*, p. 36, pl. ii, fig. 2, text-fig. 7.
? *Pagetodes antarcticus* (part), Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. v, p. 175.

Depth of body 6⅖ in the length, length of head 2⅗. Snout about ½ the length of the head; diameter of eye 4½, interorbital width 5⅘ in length of head. Maxillary extending to below middle of eye. Upper lateral line originating above the angle of the operculum, rising to below the interdorsal space, and following the profile to the base of the caudal; lower lateral line commencing above the twelfth ray of the anal and running near to the ventral profile to the base of the caudal. Dorsal III, 32; spines subequal, low, as long as diameter of eye, not higher than the rays of the soft dorsal. Anal 29. Pectoral with 24 rays, extending to above the sixth ray of the anal; pelvics about as long as pectorals, just reaching the anal. Caudal truncate. Reddish brown, with 7 darker cross-bars on body, the first two of which are slightly oblique; spinous dorsal black; other fins dusky, the pectorals being black proximally and the pelvics distally.

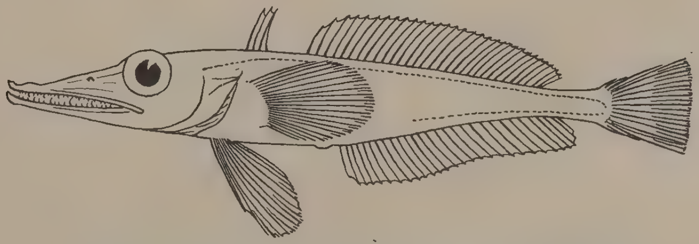

Fig. 46. *Dacodraco hunteri*. Holotype. × ½. (After Waite.)

Hab. Wilhelm Land (?); Queen Mary Land, 610 metres.

Known only from 2 specimens, both obtained by the 'Aurora' off Shackleton Ice-shelf (65° 6′ S, 96° 13′ E). The type was 211 mm. in total length.

The specimen of 69 mm., identified by Pappenheim as *Pagetodes antarcticus*, from the Winter Station of the 'Gauss', may belong here.

Genus **CHAENICHTHYS**

Channichthys, Richardson, 1844, *Ann. Mag. Nat. Hist.*, XIII (June), p. 461. Type *Channichthys rhinoceratus*, Richardson.

Chaenicthys, Richardson, 1844, *Zool. 'Erebus' and 'Terror'*, (Fish.), p. 12 (*emend. pro Channichthys*).

Chaenichthys, Günther, 1860, *Cat. Fish.*, II, p. 249; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 286 (*emend. pro Chaenicthys*).

Related to *Champsocephalus*, but there is a rostral spine, the teeth are in broader bands, and the lateral line is provided with bony plates. Gill-rakers short, dentigerous. Dorsal fins well separated.

Two species.

Kerguelen.

Chaenichthys rhinoceratus, Richardson.

Channichthys rhinoceratus, Richardson, 1844, *Ann. Mag. Nat. Hist.*, XIII (June), p. 461.

Chaenicthys rhinoceratus, Richardson, 1844, *Zool. 'Erebus' and 'Terror'*, (Fish.), p. 12, pl. VI, figs. 1–3; Gill, 1876, *Bull. U.S. Nat. Mus.*, III, p. 41.

Chaenichthys rhinoceratus (part), Günther, 1860, *Cat. Fish.*, II, p. 249.

Chaemethys rhinoceratus, Studer, 1879, *Arch. Naturg.*, XLV (1), p. 131.

Chaenichthys rhinoceratus, Günther, 1880, *Shore Fish. 'Challenger'*, p. 16; Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. V, p. 173; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 286; Monod and Dollfus, 1932, *Bull. Soc. Zool. Fr.*, LVII, p. 74; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 65.

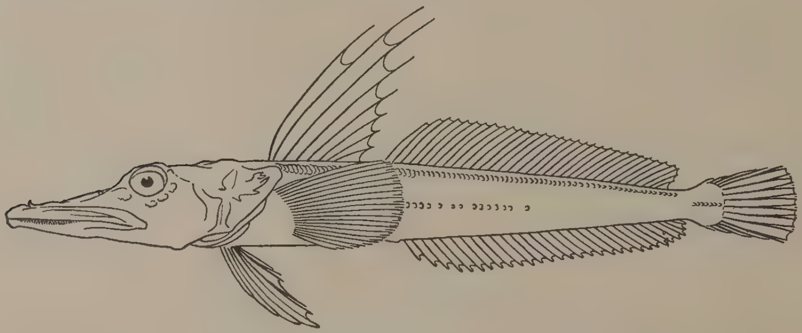

Fig. 47. *Chaenichthys rhinoceratus.* × $\frac{1}{3}$.

Depth of body $5\frac{1}{2}$ to more than 7 in the length, length of head $2\frac{2}{5}$ to nearly $2\frac{3}{4}$. Diameter of eye $5\frac{1}{2}$ to $7\frac{1}{4}$, interorbital width 5 to $6\frac{1}{2}$ in length of head. Maxillary extending to below middle of eye or beyond in adults. Head moderately or rather strongly rugose, the supraorbital edges usually not much raised. 69 to 84 plates in upper lateral line; a few plates on middle of side. Dorsal VII–VIII, 32–34; second and third spines longest, thence decreasing rapidly in length. Anal 30–33. Pectoral with 19 to 22 rays, extending to above vent or origin of anal; pelvics as long as or a little longer than pectorals, not reaching vent. Caudal rounded. Brownish, with darker spots and reticulations; spinous dorsal blackish; other fins pale or dusky.

Hab. Kerguelen.

The type of the species, 450 mm. in total length, was taken in the kelp close to the shore, the fish being caught with the hook. In addition to this specimen, and a smaller one (175 mm.) collected by the 'Challenger', several examples (300 to 510 mm.) collected by the B.A.N.Z. Antarctic Research Expedition are included in the above description.

Chaenichthys rugosus, Regan.

Chaenichthys rhinoceratus (part), Günther, 1860, *t.c.*, p. 249.
Chaenichthys rhinoceratus (*non* Richardson), Günther, 1879, *Phil. Trans. R. Soc. London*, CLXVIII (extra vol.), p. 166.
Chaenichthys rugosus, Regan, 1913, *t.c.*, p. 287; Norman, 1937, *t.c.*, p. 66.

Very closely related to *C. rhinoceratus*, but diameter of eye $7\frac{1}{4}$ to 8 in length of head; maxillary extending to or nearly to below middle of eye. Head rougher and supraorbital edges more elevated. 62 or 63 plates in upper lateral line; a nearly continuous series of plates on middle of side. Dorsal VIII, 30–31; third and fourth spines longest, fifth about as long as first. Anal 28–29. Pectoral with 18 rays, scarcely extending to above vent; pelvics longer. Nearly uniformly brownish.

Hab. Kerguelen.

The type of the species, 400 mm. in total length, has the head and body much distorted. The B.A.N.Z. Antarctic Research Expedition obtained a second example, 245 mm. in total length, which has been included in the above description. A stuffed specimen in the British Museum collection may also belong to this species.

Genus CHAENOCEPHALUS

Chaenocephalus, Regan, 1913, *t.c.*, p. 287. Type *Chaenichthys aceratus*, Lönnberg.

Body naked, elongate; two lateral lines, without distinct bony plates. A small prominence at anterior end of ethmoid; eye somewhat behind middle of head. Jaws with small sharp teeth forming rather broad bands, there being several series even at the sides; lower jaw not projecting; gill-rakers absent except for 3 or 4 very short ones below the angle of the first arch; operculum with 3 or 4 radiating ridges ending in spines, the uppermost with two or more points. Spinous dorsal well developed, its base about $\frac{1}{4}$ that of the soft dorsal, from which it is separated by an interspace; pelvics comparatively short, with the two outer rays the longest, enveloped in thick skin, but bifid, the others normally branched.

A single species.

Palmer Archipelago; South Orkneys; South Georgia.

Chaenocephalus aceratus (Lönnberg).

Chaenichthys aceratus, Lönnberg, 1906, *K. Svensk. Vet.-Akad. Handl.*, XL (5), p. 97.
Chaenocephalus aceratus, Regan, 1913, *t.c.*, p. 288, pl. xi.

St. MS 68. 3. ii. 26. East Cumberland Bay, South Georgia. Large rectangular net, 220–247 m.: 1 specimen, 515 mm.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 5 specimens, 255–420 mm.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: 2 specimens, 255, 290 mm.

St. 45. 6. iv. 26. 2·7 miles S 85° E of Jason Light, South Georgia. Large otter trawl, 270–238 m.: 1 specimen, 495 mm., with cranium of another.

St. 123. 15. xii. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 230–250 m.: 5 specimens, 147–160 mm.

St. 149. 10. i. 27. Mouth of East Cumberland Bay, South Georgia. Large otter trawl, 200–234 m.: 8 specimens, 135–160 mm.

St. 167. 20. ii. 27. Off Signy Island, South Orkneys. Net (7 mm. mesh) attached to back of trawl, 244–344 m.: 1 specimen, 210 mm.

St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago. Large otter trawl, 160–335 m.: 1 specimen, 580 mm.

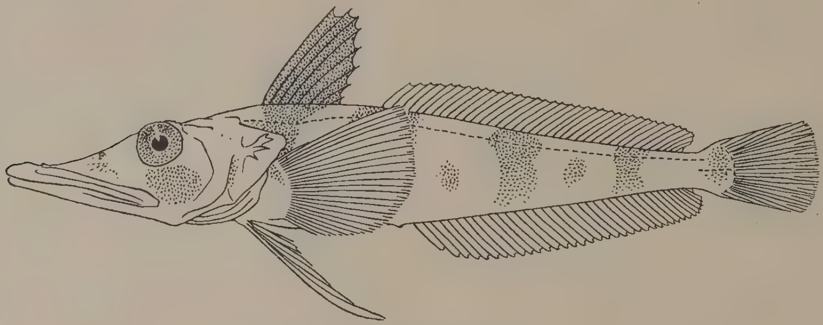

Fig. 48. *Chaenocephalus aceratus*. × ⅓.

Depth of body 5 to 7 in the length, length of head 2½ to 2⅘. Snout a little less than ½ length of head; diameter of eye about equal to interorbital width, and 5 to 6 in length of head. Maxillary extending to below middle of eye or beyond (not so far in young). Supraorbital edges raised and more or less roughened. Dorsal VII–VIII, 38–40. Anal 37–39. Pectoral with 25 or 26 rays, ⅖ to ⅔ length of head, extending to above origin or anterior rays of anal; pelvics in young longer than head and reaching to beyond middle of anal, in adult much shorter, subequal to pectorals, not reaching vent. Caudal a little rounded. Greyish or pale brownish, with 4 or 5 dark cross-bars, the first from spinous dorsal to base of pectoral, the second downwards from origin of soft dorsal, the others less regular and sometimes with narrower bars developed between them; spinous dorsal blackish or dusky; other fins more or less pale.

Hab. Palmer Archipelago; South Orkneys; South Georgia.

The type of this species was 522 mm. in total length, and was caught in Cumberland Bay at a depth of about 5 to 7 metres.

Genus CRYODRACO

? *Pagetodes*, Richardson, 1844, *Zool. 'Erebus' and 'Terror'* (Fish.), p. 15. (No type.)

Cryodraco, Dollo, 1900, *Bull. Acad. roy. Belg.* (*Classe Sci.*), No. 2, p. 129; Regan, 1913, *t.c.*, p. 288. Type *Cryodraco antarcticus*, Dollo.

Related to *Chaenocephalus*, but the rays of the pelvic fins are simple, the two outer ones enlarged and prolonged; an additional lateral line at the base of the anal fin.

Two species.

Coasts of the Antarctic Continent.

Cryodraco antarcticus, Dollo.

? *Pagetodes*, Richardson, 1844, *Zool. 'Erebus' and 'Terror'* (Fish.), p. 15, pl. viii, fig. 3.

Cryodraco antarcticus, Dollo, 1900, *Bull. Acad. roy. Belg. (Classe Sci.)*, No. 2, p. 129; 1904, *Rés. Voy. 'Belgica'*, Zool., Poiss., p. 20, pl. i, pl. v, fig. 7; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 288; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 39; Norman, 1937, *t.c.*, p. 76.

Cryodraco atkinsoni, Regan, 1914, *Ann. Mag. Nat. Hist.*, (8) XIII, p. 13; 1914, *Rep. Brit. Antarct. ('Terra Nova') Exped.* 1910, Zool. I (1), p. 11, pl. vii, fig. 2.

St. 167. 20. ii. 27. Off Signy Island, South Orkneys. Net (7 mm. mesh) attached to back of trawl, 244–344 m.: 2 specimens, 220, 230 mm.

St. 1660. 27. i. 36. 74° 46·4′ S, 178° 23·4′ E. Large otter trawl, 351 m.: 2 specimens, 245, 250 mm.

Depth of body $7\frac{1}{2}$ to $8\frac{1}{4}$ in the length, length of head $3\frac{1}{8}$ to $3\frac{1}{3}$. Snout $\frac{1}{2}$ or nearly $\frac{1}{2}$ length of head; diameter of eye 4 to $5\frac{1}{5}$, interorbital width $4\frac{2}{3}$ to more than 5 in length of head. Lower jaw not projecting; maxillary extending nearly to below middle of eye. Supraorbital edges not raised; operculum with two divergent ridges, each ending in a spine, the upper one being bi- or tri-fid. Dorsal III–V, 40–44; the membrane between the spines sometimes missing (? torn away) in young; first and second spines subequal or first a little longer than second. Anal 42–46. Pectoral with 23 to 25 rays, about $\frac{3}{5}$ length of head, extending to above anterior rays of anal; pelvics from $\frac{3}{4}$ (adult) to twice (young) length of head, extending in adults to below middle of dorsal fin or not as far, in young nearly to end of dorsal. Caudal a little emarginate. Greyish or pale brownish, with dark spots on head and with 6 or 7 dark cross-bars on body, sometimes incomplete and sometimes with irregular bars or blotches between them; spinous dorsal blackish; pelvics and distal part of caudal dusky; other fins pale.

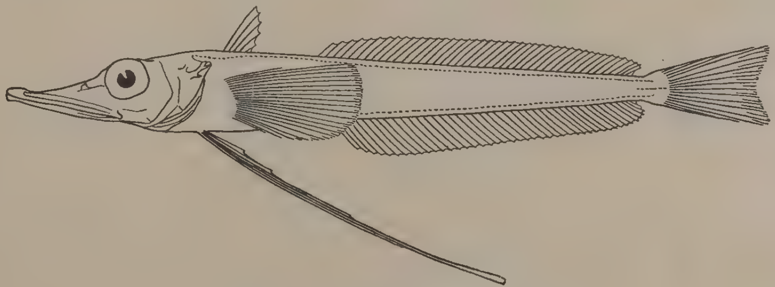

Fig. 49. *Cryodraco antarcticus*. × ½.

Hab. Graham Land; South Orkneys; Mac-Robertson Land; Queen Mary Land; South Victoria Land.

The type of the species, 200 mm. in total length, was from 71° 18′ S, 88° 2′ W, at a depth of 450 metres. The type of *C. atkinsoni*, 293 mm. in total length, is from the

Ross Sea (74° 25′ S, 179° 3′ E), at a depth of 296 metres. I have elsewhere given reasons for following Waite in regarding these species as identical.

The name *Pagetodes* was given by Richardson, without trivial name, to a fish 160 mm. in total length, which was "thrown up by the spray in a gale of wind, against the bows of the Terror, and frozen there", at 77° 10′ S, 178½° W. The specimen was unfortunately appropriated by the ship's cat before a description or detailed drawing could be made. The rough sketch published by Richardson depicts a fish not unlike a *Cryodraco*, but, as Regan has pointed out, in some characters it shows more resemblance to *Pagetopsis*. The name *Pagetodes* should, therefore, be eliminated.

Cryodraco pappenheimi, Regan.

Pagetodes antarcticus (*non* Dollo), Pappenheim, 1912, *Deutsche Südpol.-Exped.*, xiii, Zool. v, p. 175.
Cryodraco pappenheimi, Regan, 1913, *t.c.*, p. 289.

Closely related to *C. antarcticus*, but length of head 2⅗ in the length of the fish. Snout ½ length of head; diameter of eye 5, interorbital width 4 in length of head. Dorsal V, 45. Anal 39. Pelvics reaching fourteenth ray of dorsal (the prolonged rays perhaps not entire).

Hab. Wilhelm Land.

The type of the species, 168 mm. in length to base of caudal, was obtained from the stomach of a seal at the Winter Station of the 'Gauss'.

Genus CHIONODRACO

Chionodraco, Lönnberg, 1906, *K. Svensk. Vet.-Akad. Handl.*, xl (5), p. 99; Regan, 1913, *t.c.*, p. 288; 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. i (1), p. 12. Type *Chaenichthys rhinoceratus hamatus*, Lönnberg.

Body naked, elongate; three lateral lines, without bony plates. A rostral spine; eye somewhat behind middle of head; supraorbital ridges crenulated. Teeth bi- or tri-serial; gill-rakers absent except for a few vestiges near the angles of the arches; operculum with a group of 3 to 5 spines, the uppermost with 2 to 4 points; sub- and inter-operculum bearing a pair of spines just behind angle of praeoperculum. Spinous dorsal well-developed, of five to seven spines; pelvics comparatively short, of a spine and five branched or bifid rays, the two outer the longest and (in adult) enveloped in thick skin. Skeleton essentially similar to that of *Champsocephalus*. Vertebrae 64.

Two species.

Coasts of the Antarctic Continent.

Chionodraco kathleenae, Regan.

Chionodraco kathleenae, Regan, 1914, *Ann. Mag. Nat. Hist.*, (8) xiii, p. 13; 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. i (1), p. 12, pl. viii; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, iii (1), Fishes, p. 41; Norman, 1937, *t.c.*, p. 77, figs. 7 B, 9.

St. 1658. 26. i. 36. 76° 09·6′ S, 168° 40′ E. Rectangular dredge, with Russell net, 520 m.: 1 specimen, 270 mm.

Depth of body 5 to 6¼ in the length, length of head 2⅗ to 3. Snout a little less than ½ length of head; diameter of eye 4¾ to 6¼, interorbital width 3½ to about 4 in length of head. Rostral spine erect or retrorse. Jaws equal anteriorly or lower jaw projecting; maxillary extending to below anterior part or middle of eye. Dorsal V–VII, 38–45 (51); third or fourth spines generally longest; spinous dorsal separated from soft dorsal by an interspace which varies from less than $\frac{1}{4}$ to about $\frac{3}{4}$ of the length of the base of the former. Anal (33) 34–38. Pectoral with 22 to 24 rays, $\frac{1}{2}$ to nearly $\frac{3}{5}$ length of head, extending to above vent or anterior rays of anal; pelvics I 5, $\frac{1}{2}$ to $\frac{4}{5}$ length of head, reaching vent, origin of, or anterior rays of anal in young, not reaching vent in adult. Caudal subtruncate or rounded. Pale brownish or greyish; head and body with dark spots and bars; spinous dorsal blackish; other fins pale or more or less dusky.

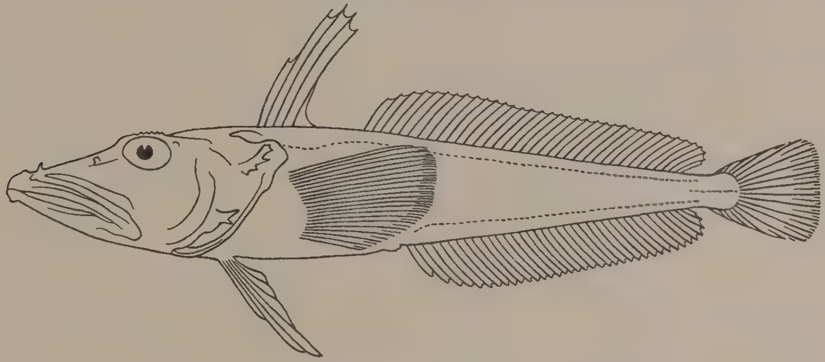

Fig. 50. *Chionodraco kathleenae*. $\times \frac{1}{4}$.

Hab. Mac-Robertson Land; Queen Mary Land; South Victoria Land.

The types of the species, 250 to 500 mm. in total length, are from the Ross Sea (74° 25′ S, 179° 3′ E), 296 metres, and McMurdo Sound, 187 to 375 metres. The B.A.N.Z. Antarctic Research Expedition obtained 16 examples, 275 to 470 mm. in total length, from off Mac-Robertson Land at a depth of 219 metres: these specimens have been included in the description of the species. Two young specimens (70 and 71 mm.) were collected by the same expedition with mid-water nets hauled obliquely from 169 metres to the surface. The eye is proportionately smaller in these young specimens, the diameter being nearly 6 in the length of the head, the pelvic fin-rays are simple, and the pelvic fins themselves are blackish in their distal parts.

Chionodraco hamatus (Lönnberg).

Chaenichthys rhinoceratus subsp. *hamatus*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 47.

Chionodraco hamatus, Lönnberg, 1906, *K. Svensk. Vet.-Akad. Handl.*, XL (5), p. 99; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 288; Norman, 1937, *t.c.*, p. 77, figs. 7 A, 8.

Closely related to *C. kathleenae*, but with a somewhat larger eye, diameter of which is $4\frac{2}{3}$ in length of head; interorbital region broader, width $3\frac{2}{5}$ in length of head. Dorsal VII, 37. Anal 33. Pelvics shorter, $\frac{1}{2}$ length of head.

Hab. Graham Land; South Shetlands.

The type of the species, 330 mm. in total length, was from south of Snow Hill, Graham Land, at a depth of 125 metres. Through the kindness of Professor Dr H.

Rendahl, I have been able to examine this specimen, and to compare it with examples of *C. kathleenae* of similar size. Two damaged specimens, 125 and 135 mm. in total length, from Deception Island, South Shetlands (taken from the stomach of a Blue Whale); and two others, 67 and 69 mm. in total length, from the stomach of a Fin Whale, captured in the Weddell Sea (65° 04′ S, 54° 12′ W), appear to belong to this species. As in the young of *C. kathleenae*, the eye is proportionately smaller in these small examples, the diameter being about 5 in the length of the head in specimens of 67 and 69 mm. The pelvic fin-rays are simple, and the pelvic fins are entirely pale.

Genus CHAENODRACO

Chaenodraco, Regan, 1914, *Ann. Mag. Nat. Hist.*, (8) xiii, p. 13; 1914, *Rep. Brit. Antarct.* (‘*Terra Nova*’) *Exped.* 1910, Zool. 1 (1), p. 12. Type *Chaenodraco wilsoni*, Regan.

Closely related to *Chionodraco*, but the supraorbital ridges are not crenulated, the gill-rakers are developed as dentigerous prominences, and the pelvic fins are each formed of a spine and only four rays.

A single species.

Coasts of the Antarctic Continent.

Chaenodraco wilsoni, Regan.

Chaenodraco wilsoni, Regan, 1914, *t.c.*, p. 13; 1914, *t.c.*, p. 12, pl. ix, fig. 1; Norman, 1937, *t.c.*, p. 79.

? *Chaenodraco fasciatus*, Regan, 1914, *t.c.*, p. 14; 1914, *t.c.*, p. 13, pl. ix, fig. 2.

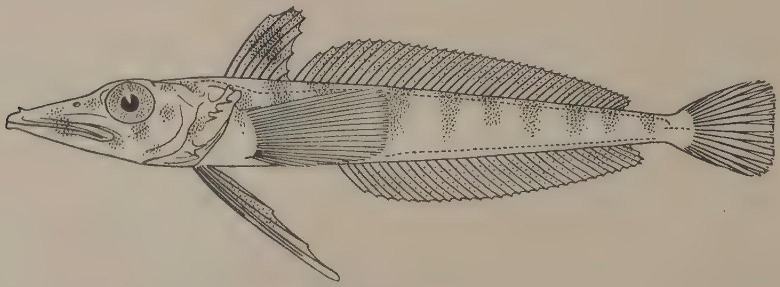

Fig. 51. *Chaenodraco wilsoni*. × ½.

Depth of body 6 to 7 in the length, length of head $2\frac{3}{5}$ to $3\frac{1}{5}$. Snout less than $\frac{1}{2}$ length of head; diameter of eye 4 (young) to $4\frac{1}{3}$, interorbital width $3\frac{3}{4}$ to $4\frac{1}{4}$ in length of head. Rostral spine antrorse. Jaws equal anteriorly or lower a little projecting; maxillary extending to below anterior $\frac{1}{4}$ or $\frac{1}{3}$ of eye. Operculum with a group of 4 or 5 spines, the uppermost bi- or tri-fid; 12 to 14 gill-rakers on lower part of anterior arch. Dorsal VI–VIII, 38–42; spinous dorsal separated from soft dorsal by a narrow interspace (young), or continuous with it at the base (adult). Anal 32–35. Pectoral with 22 to 24 rays, $\frac{3}{5}$ to nearly $\frac{2}{3}$ length of head, extending to above anterior rays of anal; pelvics I 4, as long as or nearly as long as head, extending to anterior part of anal or beyond. Caudal subtruncate or a little rounded. Pale brownish, with dark spots on the head and with 5 blackish cross-bars on the body; sometimes some additional blotches or bars between the cross-bars; a large black spot on the spinous dorsal; other fins more or less dusky.

Hab. Mac-Robertson Land; South Victoria Land.

The type of the species, 250 mm. in total length, is from McMurdo Sound, 187 to 375 metres; the type of *C. fasciatus*, 92 mm. in total length, is from McMurdo Sound (77° 13′ S, 164° 18′ E), 380 metres. I have elsewhere given reasons for regarding these species as probably identical. A number of specimens, 205 to 268 mm. in total length, collected by the B.A.N.Z. Antarctic Research Expedition, are included in the above description.

ZOARCIDAE

Key to the Antarctic Genera[1]

I. Pelvic fins present; gill-opening cleft downward at least to middle of base of pectoral.
  A. Origin of dorsal well behind base of pectoral ... ... 1. *LYCENCHELYS*
  B. Origin of dorsal above base or anterior part of pectoral
    1. Mouth large, with wide lateral cleft; anterior canines in upper jaw and lateral canines in lower; palate toothless ... ... 2. *LYCODICHTHYS.*
    2. Mouth moderate, with short lateral cleft; no well-marked canines; teeth on palate. 3. *AUSTROLYCICHTHYS.*
II. No pelvic fins; gill-opening small, above base of pectoral ... ... 4. *MELANOSTIGMA.*

Genus **LYCENCHELYS**

Lycenchelys, Gill, 1884, *Proc. Acad. N.S. Philad.*, p. 110; Regan, 1913, *Trans. R. Soc. Edinburgh*, XLIX, p. 242. Type *Lycodes muraena*, Collett.

Form elongate, with the tail long and slender, body naked. Upper jaw projecting; teeth in jaws slender, uni- or bi-serial; teeth on vomer; palatine teeth uniserial. Gill-opening rather wide, cleft downward to lower end of base of pectoral. Origin of dorsal fin well behind base of pectoral; pelvic fins present.

Several species from deep water north of the Equator; one species from the Antarctic.

Lycenchelys antarcticus, Regan.

Lycenchelys antarcticus, Regan, 1913, *t.c.*, p. 242, pl. ix, fig. 3.

Depth of body 16 in the length, length of head 6. Head as broad as deep, its breadth a little more than $\frac{1}{3}$ its length. Snout twice as long as eye, diameter of which is 6 in length of head; interorbital width about 16. Muciferous channels of sides of head and lower jaw with large pores. Teeth in jaws rather slender and obtuse, uniserial, biserial near symphysis of lower jaw; teeth on palate acute, wide-set. About 110 rays in dorsal fin, 9 in caudal, 103 in anal; origin of anal at a distance behind head equal to the length of the latter, $\frac{1}{3}$ as distant from vertical through origin of dorsal as from that through base of pectoral; pectoral a little more than $\frac{1}{2}$ as long as head. Bluish-grey; head darker; fins brownish grey.

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[1] In 1885, Fischer (*Jahrb. Hamburg. Wiss. Anst.*, II, p. 60, pl. ii, fig. 9) described and figured a new genus and species of Zoarcid fish, *Gymnelichthys antarcticus*. The description was based upon 4 specimens, 110 to 220 mm. in total length, said to be from South Georgia. Through the kindness of Miss Erna Mohr, I have been able to examine three of these types, now preserved in the Hamburgisches Zoologisches Museum und Institut: No. 3902, 2 specimens, 110 and 120 mm.; No. 3942, 1 specimen, 183 mm.

As was the case with Fischer's genus of Cottidae, *Sclerocottus schraderi* (see Norman, 1935, *Copeia*, No. 3, p. 141), it seems likely that the type locality is incorrect, and that the fish were never collected at South Georgia. Comparison of these type specimens with material in the British Museum shows that they are referable to a species of Zoarcid common in *Arctic* seas, namely, *Gymnelis viridis* (Fabricius).

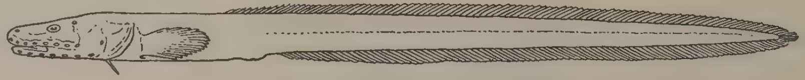

Fig. 52. *Lycenchelys antarcticus*. Holotype. × 1.

Hab. Near the South Orkneys.

The type of the species, 128 mm. in total length, was obtained by the 'Scotia' at Station 313 (62° 10′ S, 41° 20′ W), at a depth of 3225 metres. The specimen is preserved in the Royal Scottish Museum (Bruce collection), and I am indebted to the authorities of the museum for the loan of this fish for examination.

Genus LYCODICHTHYS

Lycodichthys, Pappenheim, 1911, *Sitzungsb. Ges. Naturf. Freunde*, p. 382; 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. V, p. 180; Regan, 1913, *t.c.*, p. 244. Type *Lycodichthys antarcticus*, Pappenheim.

Form moderately elongate; body with rounded scales embedded in the skin. Upper jaw projecting; mouth large, with wide lateral cleft; teeth conical, uniserial; anterior pair in upper jaw enlarged; lateral teeth of lower jaw spaced, canine-like; palate toothless. Gill-opening rather wide, cleft downward almost to lower end of base of pectoral. Origin of dorsal fin just behind head, above anterior part of pectoral; pelvic fins present.

A single species from the coasts of the Antarctic Continent.

Lycodichthys antarcticus, Pappenheim.

Lycodichthys antarcticus, Pappenheim, 1911, *t.c.*, p. 383; 1912, *t.c.*, p. 180, pl. IX, fig. 6, pl. X, fig. 4; Regan, 1913, *t.c.*, p. 244; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 14.

Depth of body 8 or 9 in the length, length of head 5 to $5\frac{1}{2}$. Diameter of eye 5 to 6 in length of head. Maxillary extending to below posterior margin of eye or a little beyond. Dorsal with 85 to 90 rays, anal with about 65, caudal with about 10; origin of anal 1 to $1\frac{1}{3}$ head-lengths behind head; pectoral $\frac{1}{2}$ length of head. Yellowish brown; head, body and fins spotted or marbled with darker brown.

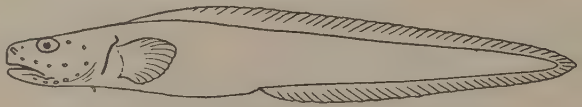

Fig. 53. *Lycodichthys antarcticus*. × $\frac{1}{2}$.

Hab. Wilhelm Land.

This species was originally described from 25 specimens, 110 to 200 mm. in total length, from the Winter Station of the 'Gauss', depth 385 metres: 2 co-types, 160 and 200 mm. in total length, are in the collection of the British Museum.

Genus AUSTROLYCICHTHYS

Austrolycichthys, Regan, 1913, *t.c.*, p. 244. Type *Lycodes brachycephalus*, Pappenheim.

Form elongate, compressed; body with rounded scales embedded in the skin. Jaws level anteriorly or upper somewhat projecting; mouth moderate, with short lateral cleft; teeth conical, in two or more series in both jaws, at least anteriorly; no well-marked canines; teeth on vomer and palatines. Gill-opening cleft downward at least to middle of base of pectoral. Origin of dorsal fin just behind head, above or a little behind base of pectoral; pelvic fins present.

Three species from Antarctic Seas.

Key to the Species

I. Gill-opening cleft downward nearly to lower end of base of pectoral; tail from less than $1\frac{1}{2}$ to about $1\frac{3}{4}$ times as long as rest of fish; anal with about 68 to 70 rays; inside of mouth pale.

  A. Pores on head not very conspicuous; origin of anal $1\frac{2}{5}$ to $1\frac{2}{3}$ head-lengths behind head; upper jaw a little projecting ... ... 1. *brachycephalus.*

  B. Pores on head very conspicuous; origin of anal a little more than 1 head-length behind head; upper jaw strongly projecting ... ... 2. *concolor.*

II. Gill-opening cleft downward to a little below middle of base of pectoral; tail about $2\frac{1}{4}$ times as long as rest of fish; anal with about 90 rays; inside of mouth blackish. 3. *bothriocephalus.*

Austrolycichthys brachycephalus (Pappenheim).

Lycodes brachycephalus, Pappenheim, 1912, *Deutsche Südpol.-Exped.*, XIII, Zool. v, p. 179, pl. x, fig. 3.

Austrolycichthys brachycephalus, Regan, 1913, *t.c.*, p. 244, text-fig. 2; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 15, pl. i, fig. 1, text-figs. 2, 2*a*.

St. 1652. 23. i. 36. 75° 56·2′ S, 178° 35·5′ E. Rectangular dredge, with Russell net, 567 m.: 1 specimen, 280 mm.

Depth of body 8 to $10\frac{1}{2}$ in the length, length of head $5\frac{4}{5}$ to $6\frac{2}{3}$. Tail from less than $1\frac{1}{2}$ to $1\frac{3}{4}$ times as long as rest of fish. Pores on head not conspicuous. Diameter of eye 5 to nearly 6 in length of head. Maxillary extending to below anterior part of eye; upper jaw a little projecting; teeth in 2 or 3 series anteriorly, usually becoming uniserial laterally; vomerine teeth in a group, palatine teeth in 2 rows. Gill-opening cleft downward to or nearly to lower end of base of pectoral. Dorsal with about 90 rays, anal with about 70, caudal with 10; origin of anal $1\frac{2}{5}$ to $1\frac{2}{3}$ head-lengths behind head; pectoral $\frac{2}{3}$ to $\frac{4}{5}$ length of head. Greyish or brownish; inside of mouth pale.

Hab. Wilhelm Land; Queen Mary Land; South Victoria Land.

This species was originally described from 58 specimens from the Winter Station of the 'Gauss', depth 380 metres, of which 2 examples, 150 and 155 mm. in total length, are in the collection of the British Museum. The 'Aurora' obtained other examples from off Shackleton Ice-shelf (65° 6′ S, 96° 13′ E), 600 metres, and off the Western Base (66° 18′ S, 94° 58′ E), 494 metres.

Austrolycichthys concolor (Roule & Despax).

Lycodes concolor, Roule and Despax, 1911, *Bull. Mus. Paris*, 1911, No. 5, p. 279; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 19, pl. ii, fig. 3, pl. iii, fig. 6.

St. 195. 30. iii. 27. Admiralty Bay, King George Island, South Shetlands. Net (7 mm. mesh) attached to back of trawl, 391 m.: 1 specimen, 125 mm.

Depth of body $9\frac{3}{4}$ in the length, length of head about $5\frac{3}{5}$. Tail about $1\frac{3}{4}$ times as long as rest of fish. Pores on head large and conspicuous. Diameter of eye nearly 5 in length of head, nearly equal to interocular width. Maxillary extending to beyond anterior margin of eye; upper jaw strongly projecting; several rows of small teeth in each jaw; a small group of teeth on the vomer and a single tooth on each palatine. Gill-opening cleft downward to lower end of base of pectoral. Dorsal with about 75 rays, anal with about 70, caudal with about 10; origin of anal a little more than a head-length behind head; pectoral about $\frac{3}{5}$ length of head. Pale yellowish-brown, the upper parts of the sides irregularly marbled with darker.

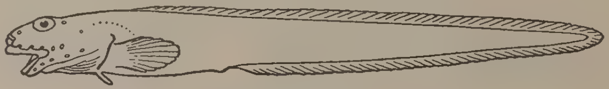

Fig. 54. *Austrolycichthys concolor.* × $\frac{3}{4}$.

Hab. South Shetlands.

The above specimen agrees well with the description of the type, which was 175 mm. in total length. I am indebted to Dr C. F. Angel for information concerning the type specimen preserved in the Paris Museum (No. 11—99).

Austrolycichthys bothriocephalus (Pappenheim).

Lycodes bothriocephalus, Pappenheim, 1912, *t.c.*, p. 178, pl. x, fig. 2.

Austrolycichthys bothriocephalus, Regan, 1913, *t.c.*, p. 245; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, 1, p. 80, fig. 10.

Depth of body 11 in the length, length of head a little more than 6. Tail about $2\frac{1}{4}$ times rest of fish. Pores on head very large and conspicuous. Diameter of eye about 5 in length of head. Maxillary extending to below anterior margin of eye; jaws level anteriorly; teeth small, in 2 or 3 series anteriorly in both jaws, becoming uniserial laterally; a small patch of teeth on the vomer and a pair of teeth (placed one behind the other) on each palatine. Gill-opening cleft downward to a little below middle of base of pectoral. Dorsal with about 110 rays, anal with about 90, caudal with about 10; origin of anal about one head-length behind the head; pectoral about $\frac{2}{3}$ length of head. Brownish, irregularly and faintly variegated with paler; inside of mouth and branchial cavities blackish.

Hab. Enderby Land; Wilhelm Land.

The type of the species, 181 mm. in total length, was from the Winter Station of the 'Gauss', depth 380 metres. The above description is based upon another specimen, 114 mm. long, obtained by the B.A.N.Z. Antarctic Research Expedition off Enderby Land (66° 12′ S, 49° 37′ E), at a depth of 300 metres, which appears to belong to Pappenheim's species.

Genus **MELANOSTIGMA**

Melanostigma, Günther, 1881, *Proc. Zool. Soc.*, p. 21; Regan, 1913, *t.c.*, p. 248; Norman, 1937, *Discovery Rep.*, XVI, p. 109. Type *Melanostigma gelatinosum*, Günther.

Form elongate, compressed; body naked. Mouth terminal; teeth uniserial in both jaws and on vomer and palatines. Gill-opening small, above base of pectoral. Origin of dorsal fin just behind head; no pelvic fins.

Several species from deep water in the Atlantic and Pacific; one from the Subantarctic and Antarctic Zones.

Melanostigma gelatinosum, Günther.

Melanostigma gelatinosum, Günther, 1881, *t.c.*, p. 21, pl. ii, fig. A; Regan, 1913, *t.c.*, p. 248; Norman, 1937, *t.c.*, p. 109.

St. 1082. 29. xii. 32. 53° 44′ S, 38° 30·9′ W. 1 m. tow-net, oblique, 290–120 m.: 1 specimen, 205 mm.

Depth of body 7 to 10 in the length, length of head 6. Diameter of eye $3\frac{1}{3}$ to 4 in length of head, interorbital width 8 to about 12. Mouth oblique; maxillary extending to below middle of eye. Origin of anal a head-length behind head; pectoral nearly $\frac{1}{2}$ length of head. Pale yellowish-brown, the sides in young spotted and marbled with purplish-grey; end of tail blackish; inside of mouth and gill-openings black.

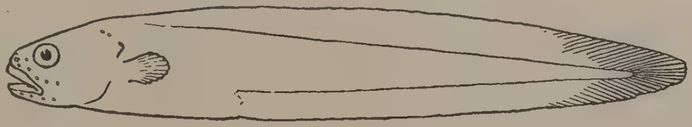

Fig. 55. *Melanostigma gelatinosum.* × $\frac{1}{2}$.

Hab. Straits of Magellan; north-west of South Georgia.

The type of the species, 140 mm. in total length, was captured at a depth of about 45 metres. This represents one of the very few species found both in the Antarctic and Subantarctic Zones.

CONGIOPODIDAE

Zanclorhynchus spinifer, Günther.

Zanclorhynchus spinifer, Günther, 1880, *Shore Fish. 'Challenger'*, p. 15, pl. viii, fig. A; Waite, 1916, *Austral. Antarct. Exped. Sci. Rep.*, Ser. C, III (1), Fishes, p. 72; Norman, 1937, *Rep. B.A.N.Z. Antarct. Res. Exped.*, Ser. B, I, p. 59, fig. 4.

Hab. Kerguelen; Macquarie Island.

The type of the species from Kerguelen is 90 mm. in total length. Waite recorded two specimens (202 and 238 mm.) from Macquarie Island, and the B.A.N.Z. Antarctic Research Expedition obtained 7 specimens (50 to 175 mm.).

LIPARIDAE

Paraliparis gracilis, Norman.

Paraliparis gracilis, Norman, 1930, *Discovery Rep.*, II, p. 352, fig. 42.

St. 39. 25. iii. 26. East Cumberland Bay, South Georgia. Large otter trawl, 179–235 m.: 15 specimens, 40–115 mm.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. Large otter trawl, 120–204 m.: 2 specimens, 103, 115 mm.

St. WS 32. 21. xii. 26. Mouth of Drygalski Fjord, South Georgia. Small beam trawl, 91–225 m.: 2 specimens, 45, 58 mm.

St. 142. 30. xii. 26. East Cumberland Bay, South Georgia. Net (4 mm. mesh) attached to back of trawl, 88–273 m.: 5 specimens, 52–95 mm.

St. 154. 18. i. 27. Jason Harbour to Larsen Point, South Georgia. Net (4 mm. mesh) attached to back of trawl, 60–160 m.: 9 specimens, 42–50 mm.

Depth of body 5 to 5½ in the length, length of head 4⅘ to nearly 6. Diameter of eye about 3 in length of head. Dorsal 58–66. Anal 56–63. Pectoral with an upper portion of 10 to 12 rays.

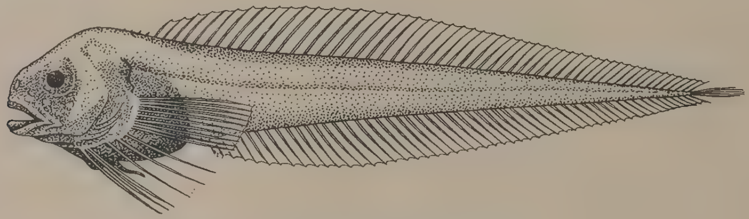

Fig. 56. *Paraliparis gracilis*. Holotype. × 1½.

Hab. South Georgia and neighbourhood.

The holotype of the species, 70 mm. in total length, is from 53° 48′ 00″ S, 35° 37′ 30″ W, 728 metres. The other Antarctic species are *P. antarcticus*, Regan [? = *P. wildi*, Waite]; and *P. terrae-novae*, Regan. I have given a key to these species in my report on the oceanic fishes (1930, *t.c.*, p. 352).

Careproctus georgianus, Lönnberg.

Careproctus georgianus, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 41, pl. iii, fig. 11; Burke, 1930, *Bull. U.S. Nat. Mus.*, CL, p. 122.

St. MS 68. 2. iii. 26. East Cumberland Bay, South Georgia. Large rectangular net, 220–247 m.: 1 specimen, 55 mm.

St. 142. 30. xii. 26. East Cumberland Bay, South Georgia. Nets (4 mm. and 7 mm. mesh) attached to back of trawl, 88–273 m.: 7 specimens, 27–90 mm.

St. 144. 5. i. 27. Off mouth of Stromness Harbour, South Georgia. Large otter trawl, 155–178 m.: 3 specimens, 12–14 mm.

Depth of body 4⅗ to about 5 in the length, length of head 4 to 4¾. Diameter of eye ½ interorbital width, about 4 in length of head. Teeth simple. Gill-opening above base of pectoral. Dorsal 45–52. Anal 42–46. Pectoral with about 30 rays.

Hab. South Georgia.

This species, which was not previously represented in the British Museum collection, was originally described from 2 specimens, 63 and 105 mm. in total length, from South Fjord, Cumberland Bay, depth 195 metres.

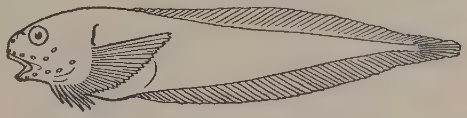

Fig. 57. *Careproctus georgianus*. × ¾.

Liparis steineni, described by Fischer (1885, *Jahrb. Hamb. Wiss. Anst.*, II, p. 63) may belong to this genus. The types, 2 specimens 65 and 70 mm. in total length, were said to be from tide pools or shallow waters, Royal Bay, South Georgia.

BOTHIDAE

Mancopsetta maculata (Günther).

Lepidopsetta maculata, Günther, 1880, *Shore Fish. 'Challenger'*, p. 18, pl. xxx, fig. C; Norman, 1930, *Discovery, Rep.*, II, p. 361.

Mancopsetta maculata, Norman, 1934, *Syst. Monogr. Flatfish.*, I, p. 248, fig. 189.

St. 158. 21. i. 27. 53° 48′ 30″ S, 35° 57′ 00″ W. Large dredge, 401–411 m.: 1 specimen, 270 mm.

Hab. South Atlantic, north of the Falkland Islands; north-east of South Georgia; southern Indian Ocean, near Prince Edward's Island.

The type of the species, 134 mm. in total length, was collected by the 'Challenger' at Station 145, at a depth of 580 metres. The 'William Scoresby' obtained another example, 238 mm. long, from 45° 45′ 00″ S, 59° 35′ 00″ W, at a depth of 311 to 247 metres. This represents another species found in both the Antarctic and Subantarctic Zones.

GENERAL PART

THE ANTARCTIC ZONE

In his report on the fishes of the 'Terra Nova' Expedition, Regan (1914*b*) has discussed in detail the distribution of Antarctic and Subantarctic fishes, and has defined three zones of distribution south of the Tropical Zone, namely, the South Temperate Zone, the Subantarctic Zone, and the Antarctic Zone. This last region was said to include "the coasts of the Antarctic continent and the islands that lie to the south of the isotherm of 6° C., with the possible exception of Macquarie Island". This zone was further subdivided into two districts, Glacial and Kerguelen. The Glacial District includes the coasts of the Antarctic continent and neighbouring islands, together with South Georgia, the South Sandwich Islands, and Bouvet Island, all situated within the extreme limit of the pack-ice. The Kerguelen District includes the island of Kerguelen and also Heard Island, the Crozet Islands, and Marion and Prince Edward Islands: as will be seen, there appears to be good reason for including Macquarie Island within this district.

The mean annual surface isotherms of 6° C. and 12° C. correspond on the whole fairly closely to the Antarctic and Subtropical Convergences as delimited by Deacon[1] in his valuable paper on the hydrology of the Southern Ocean. The following classification for the distribution of Antarctic Fishes, therefore, follows almost exactly that proposed by Regan:

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[1] 1937, *Discovery Reports*, XV, pp. 1–124, pls. i–xliv.

ANTARCTIC ZONE. The area bounded to the north by the Antarctic Convergence.

Glacial District. Antarctic Continent; South Shetlands; South Orkneys; South Sandwich Islands; South Georgia; Bouvet Island.

Kerguelen-Macquarie District. Kerguelen; Heard Island; Crozets; Marion and Prince Edward Islands; Macquarie Island.

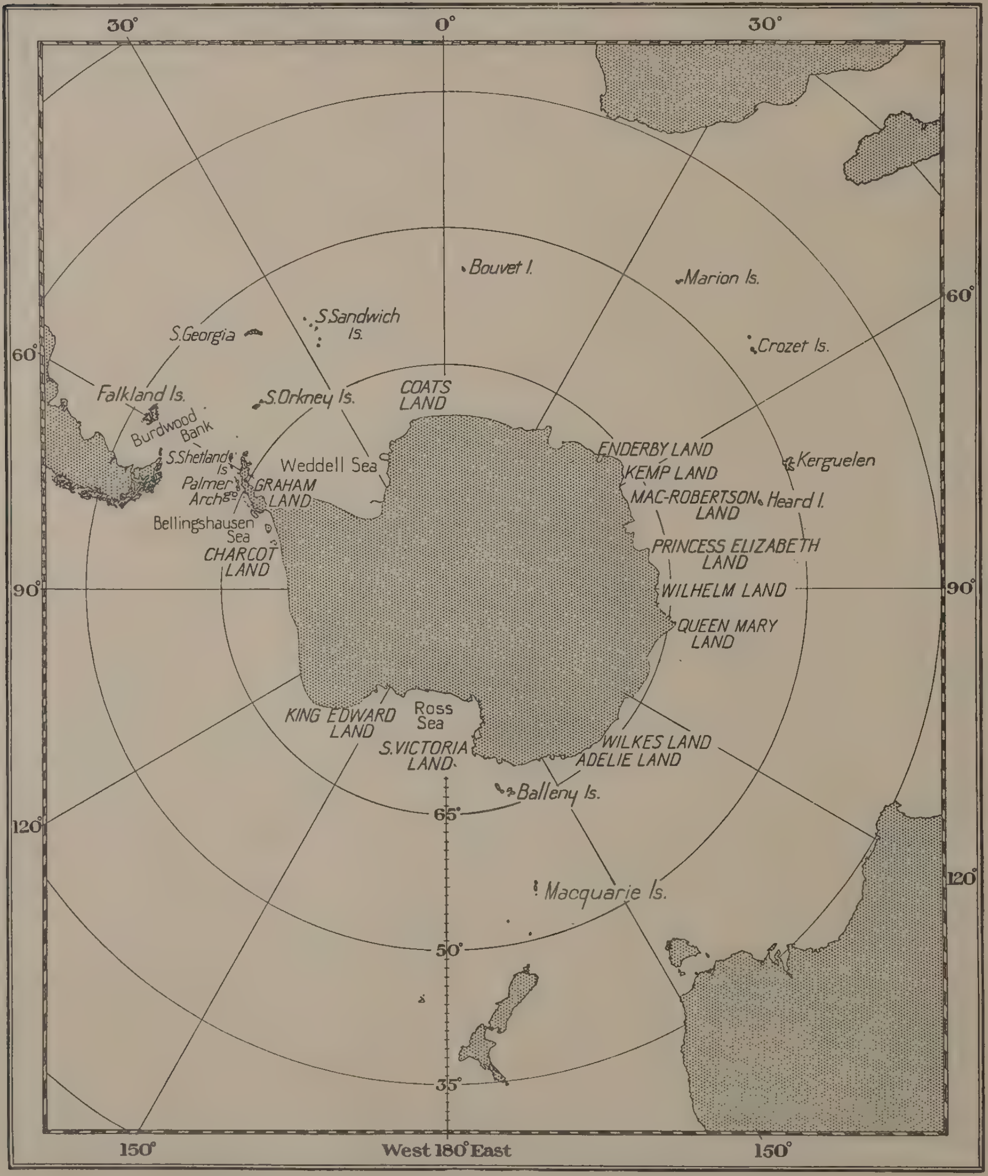
30°
0°
30°
60°
60°
90°
90°
120°
120°
150°
West 180° East
150°
65°
50°
35°
Bouvet I.
Marion Is.
S.Sandwich Is.
S.Georgia
Crozet Is.
Falkland Is.
S.Orkney Is.
COATS LAND
Burdwood Bank
S.Shetland Is.
Weddell Sea
ENDERBY LAND
KEMP LAND
Kerguelen
Palmer Archge
GRAHAM LAND
MAC-ROBERTSON LAND
Heard I.
Bellingshausen Sea
CHARCOT LAND
PRINCESS ELIZABETH LAND
WILHELM LAND
QUEEN MARY LAND
KING EDWARD LAND
Ross Sea
S.VICTORIA LAND
WILKES LAND
ADELIE LAND
Balleny Is.
Macquarie Is.

Fig. 58. Map showing the principal localities mentioned in the text.

HISTORICAL[1]

The voyages of the 'Erebus' and 'Terror', under the command of Sir J. C. Ross, during the years 1839 to 1843, resulted in the first specimens of fishes from the Antarctic Zone being brought to this country, examples of four species being collected at Kerguelen.

The fishes were reported upon by Richardson (1844–1848) who gave the following names to the species from Kerguelen:

Notothenia cyanobrancha, Richardson.
N. purpuriceps, Richardson (*N. cyanobrancha*).
N. coriiceps, Richardson.
Chaenichthys rhinoceratus, Richardson.

The following species was described from an unknown locality, but was quite likely captured at Kerguelen:

Notothenia? rossii, Richardson.

In addition, Richardson mentions three other fishes in his report, which appear to have been obtained in the true Glacial District:[2]

Sphyraena. (?? *Gymnodraco acuticeps*.)
Notothenia phocae, Richardson. (An unidentifiable Nototheniid.)
Pagetodes, Richardson (? *Cryodraco antarcticus*).

During the years 1874 to 1875 two expeditions visited Kerguelen to observe the "Transit of Venus", both of which collected a few specimens of fishes during their stay on the island.

The fishes collected by the American expedition were dealt with by Gill (1876), who recorded the following species from the Antarctic Zone for the first time:

Harpagifer bispinis (Schneider).

Günther (1879) reported upon the specimens obtained by the British expedition, and described a new species of Ray from this district:

Raja eatonii, Günther.

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[1] A valuable historical summary of early Antarctic voyages, commencing with that of Captain Cook in the years 1772–1775, has been given by Dollo (1904, pp. 5–11).

[2] Concerning the first two of these, Richardson (p. 8) writes: "On the 14th of January 1842, when the ships were embayed among ice on the 65th parallel of south latitude and about the 155th west meridian, a seal was taken with twenty-eight pounds of fish in its stomach. The fish were of two kinds, one a *Sphyraena*, the other a *Notothenia*, of which there were many mutilated individuals. Dr Hooker made a careful drawing of the most perfect, and put several examples in spirits...." I have been quite unable to trace either the drawing or the spirit specimens, so that *Notothenia phocae* must be regarded as unidentifiable, since the description is quite inadequate. No description of the *Sphyraena* is given, but Dollo (1904, p. 9) has suggested that this may have been a specimen of *Gymnodraco acuticeps*, Boulenger.

Concerning *Pagetodes*, he writes: "When the ships were in the high latitude of 77° 10′ S, and long. 178½° [W], a fish was thrown up by the spray in a gale of wind, against the bows of the Terror and frozen there." Unfortunately, this specimen, which was 160 mm. in total length, was appropriated by the ship's cat before a detailed drawing or description could be made, and the rough sketch reproduced by Richardson (pl. viii, fig. 3) is not sufficiently accurate, to admit of positive identification. It seems probable, however, that this fish was of the same species as that described later by Dollo as *Cryodraco antarcticus*.

The S.M.S. 'Gazelle' (1874–1876), under the command of Captain F. von Schleinitz, visited Kerguelen during her voyage. The zoological results were edited by Studer (1889), but the single new fish obtained from this zone had been previously described by Peters (1876):

Notothenia antarctica, Peters (*N. macrocephala*).

The 'Challenger', under the command of Sir G. S. Nares, made valuable collections at Kerguelen, Marion Island and Prince Edward's Island, which were reported upon by Günther (1880, 1887), and the following additions made to the fish-fauna of the Kerguelen District:

Raja murrayi, Günther.
Muraenolepis marmoratus, Günther.
Notothenia acuta, Günther.
N. marionensis, Günther.
N. mizops, Günther.
N. squamifrons, Günther.
Bathydraco antarcticus, Günther.
Zanclorhynchus spinifer, Günther.
Lepidopsetta maculata, Günther (*Mancopsetta maculata*).

The 'Deutschen Polarkommission' (1882–1883) obtained a few fishes from South Georgia, which were described by Fischer (1885), who added the following species to the list of Antarctic fishes:[1]

Notothenia marmorata, Fischer (*N. rossii*).
N. angustifrons, Fischer.
Chaenichthys georgianus, Fischer (*Parachaenichthys georgianus*).
Liparis steineni, Fischer (? *Careproctus steineni*).

The voyage of the S.Y. 'Belgica' (1897–1899), under the command of A. de Gerlache de Gomery, with Dr E. G. Racovitza as naturalist, led to the addition of the following species to the list. The collection, which included the first fishes actually obtained from within the Antarctic Circle,[2] was reported upon by Dollo (1900, 1904):

Raja arctowskii, Dollo.
Gerlachea australis, Dollo.
Racovitzia glacialis, Dollo.
Cryodraco antarcticus, Dollo.

The 'Southern Cross' (1898–1900), under the command of Mr C. E. Borchgrevink, obtained a valuable collection of fishes, working mainly in the Victoria Quadrant. These were described by Boulenger (1902), and the following added to the list:

Notothenia nicolai, Boulenger (*Trematomus nicolai*).
Trematomus newnesi, Boulenger.
T. borchgrevinki, Boulenger.
T. hansoni, Boulenger.
T. bernacchii, Boulenger.
Pleuragramma antarcticum, Boulenger.
Gymnodraco acuticeps, Boulenger.

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[1] See footnote on p. 81 of this report.

[2] This expedition worked mainly in the Weddell Quadrant, but one or two specimens were obtained from the Ross Quadrant.

The Swedish South Polar Expedition, with the 'Antarctic', under the direction of Dr O. Nordenskjöld, visited South Georgia, and also made collections of fishes at Graham Land and the neighbouring islands (Weddell Quadrant). The fishes were reported upon by Lönnberg (1905), who added the following to the Antarctic list:

Muraenolepis marmoratus microps, Lönnberg (*M. microps*).
Notothenia dubia, Lönnberg (? *Trematomus vicarius*).
N. mizops nudifrons, Lönnberg (*N. nudifrons*).
N. larseni, Lönnberg.
N. gibberifrons, Lönnberg.
Trematomus hansoni georgianus, Lönnberg (*T. hansoni*).
T. bernacchii vicarius, Lönnberg (*T. vicarius*).
Artedidraco mirus, Lönnberg.
A. skottsbergi, Lönnberg.
Champsocephalus gunnari, Lönnberg.
Chaenichthys rhinoceratus hamatus, Lönnberg (*Chionodraco hamatus*).
Careproctus georgianus, Lönnberg.

The German South Polar Expedition (1901–1903), with the 'Gauss', under the leadership of Erich von Drygalski, visited Kerguelen and also collected near the boundary between the Victoria and Enderby Quadrants of the Antarctic Continent. The fishes were dealt with by Pappenheim (1911, 1912), who added the following new species:

Notothenia lepidorhinus, Pappenheim (*Trematomus lepidorhinus*).
Trematomus brachysoma, Pappenheim.
Lycodes bothriocephalus, Pappenheim (*Austrolycichthys bothriocephalus*).
L. brachycephalus, Pappenheim (*Austrolycichthys brachycephalus*).
Lycodichthys antarcticus, Pappenheim.

The National Antarctic Expedition (1901–1904), with the 'Discovery' under Captain R. F. Scott, obtained a few specimens in the Victoria Quadrant, which were described by Boulenger (1907). The following species were added to the Antarctic list:

Notothenia scotti, Boulenger (*Trematomus scotti*).
N. hodgsoni, Boulenger (*Trematomus newnesi*).
Bathydraco macrolepis, Boulenger.
Champsocephalus macropterus, Boulenger (*Pagetopsis macropterus*).

The Scottish National Antarctic Expedition (1902–1904), with the 'Scotia', under the leadership of Dr W. S. Bruce, made important collections in the neighbourhood of the South Orkneys and Coats Land in the Weddell Quadrant. Dollo (1906, 1907, 1908, 1909) presented several preliminary descriptions of fishes obtained by this expedition, but the complete report was prepared by Regan (1913). A complete monograph of the Nototheniiform fishes was included in this report, and the following species were added to the list:

Notothenia vaillanti, Regan (*N. gibberifrons*).
Trematomus loennbergii, Regan.
Bathydraco scotiae, Dollo.
Chaenichthys rugosus, Regan.
Cryodraco pappenheimi, Regan.

The French Antarctic Expedition (1903–1905), with the 'Français', under the command of Dr Jean Charcot, collected off Graham Land and the neighbouring islands (Weddell Quadrant). The fishes were described by Vaillant (1905, 1906), who added the following new names to the faunal list:

Dissostichus eleginoides Smitt (*D. mawsoni*).
Chaenichthys charcoti, Vaillant (*Parachaenichthys charcoti*).

Lönnberg (1906) described some fishes from South Georgia, collected by Mr Erich Sörling, and added one new species to the list of those known from the island:

Chaenichthys aceratus, Lönnberg (*Chaenocephalus aceratus*).

The British Antarctic Expedition (1907–1909), with the 'Nimrod', under the command of Sir Ernest Shackleton, collected a few fishes in the Victoria Quadrant, which were reported upon by Waite (1911), who added one new species:

Artedidraco shackletoni, Waite.

The Second French Antarctic Expedition (1908–1910), with the 'Pourquoi-Pas?', under the command of Dr Jean Charcot, made valuable collections in the Weddell Quadrant of the Antarctic. These were studied by Roule and Despax (1911) and by Roule, Angel and Despax (1913), who described three new forms:

Artedidraco loennbergi, Roule.
Dolloidraco longedorsalis, Roule.
Lycodes concolor, Roule and Despax (*Austrolycichthys concolor*).

The British Antarctic ('Terra Nova') Expedition (1910), under Captain R. F. Scott, made very rich collections of fishes in the Victoria Quadrant. These were reported upon by Regan (1914, 1916), who described the following new species:

Trematomus pennellii, Regan.
T. centronotus, Regan.
T. eulepidotus, Regan.
Artedidraco orianae, Regan.
Histiodraco velifer, Regan.
Pogonophryne scotti, Regan.
Prionodraco evansii, Regan.
Cryodraco atkinsoni, Regan (*C. antarcticus*).
Chionodraco kathleenae, Regan.
Chaenodraco wilsoni, Regan.
C. fasciatus, Regan (? *C. wilsoni*).
Paraliparis antarcticus, Regan.
P. terrae-novae, Regan.

The Australasian Antarctic Expedition (1911–1914), with the 'Aurora', under the leadership of Sir Douglas Mawson, obtained a number of fishes from Macquarie Island and from the Victoria Quadrant of the Antarctic continent. These were described by Waite (1916), who added the following names to the Antarctic list:

Notothenia coriiceps var. *macquariensis*, Waite (*N. rossii*).
Bathydraco nudiceps, Waite.
Aconichthys harrissoni, Waite (*Racovitzia harrissoni*).

Cygnodraco mawsoni, Waite.
Dacodraco hunteri, Waite.
Paraliparis wildi, Waite (? *P. antarcticus*).

Finally, the British, Australian, New Zealand Antarctic Research Expedition (1929–1931), with the 'Discovery', under the leadership of Sir Douglas Mawson, made extensive collections in the Victoria and Enderby Quadrants of the Antarctic, and also obtained fishes from Kerguelen, Heard Island, the Crozets, and from Macquarie Island. The fishes were reported upon by Norman (1937), who described two new forms:

Muraenolepis microcephalus, Norman.
Dissostichus mawsoni, Norman.

DISTRIBUTION OF ANTARCTIC COAST FISHES

It has been pointed out in the introduction to this report that, of the 86 species of fish recorded from the Antarctic Zone, 65 (75 per cent) belong to the Percoid Division Nototheniiformes. Taking the Glacial District alone, the percentage rises to 76, and for the coasts of the Antarctic Continent it is nearly 85. It follows, therefore, as Regan (1914*b*, p. 26) has pointed out, that this group of fishes is of paramount importance in delimiting an Antarctic region or zone. The table on page 95 shows the distribution of those species of Nototheniiform fishes occurring within the area bounded by the Antarctic Convergence (fig. 59). The Glacial District is dealt with first, the four quadrants of the Antarctic Continent preceding the more outlying islands; the localities of the Kerguelen-Macquarie District follow, and finally the Subantarctic districts—the Patagonian region and the Antipodes.

A glance at the two right-hand columns shows at once the importance of the Convergence as a boundary for Antarctic coast fishes. Of the 65 species listed, only three (*Notothenia macrocephala*, *N. colbecki*, *Harpagifer bispinis*) occur also in the Subantarctic Zone, and only one of these (*H. bispinis*) is common to the Glacial District and the Subantarctic Zone. Of the 26 genera listed, 21 are peculiar to the Glacial District, 1 is peculiar to the Kerguelen-Macquarie District, and 4 are found also in the Subantarctic Zone. Of these four genera, *Harpagifer* is monotypic, *Dissostichus* and *Champsocephalus* each have one species in the Antarctic and one in the Subantarctic Zone, and the large genus *Notothenia* is well represented in both zones.

Regan (*t.c.*, p. 29) has shown that the species of *Notothenia* form five natural groups, and the species occurring in the Antarctic Zone may be distributed in these groups as follows:

"*tessellata*" group	"*squamifrons*" group	"*acuta*" group	"*marionensis*" group	"*coriiceps*" group
	squamifrons *kempi* *larseni*	*mizops* *nudifrons* *gibberifrons* *acuta*	*angustifrons* *marionensis*	*coriiceps* *rossii* *macrocephala* *colbecki*

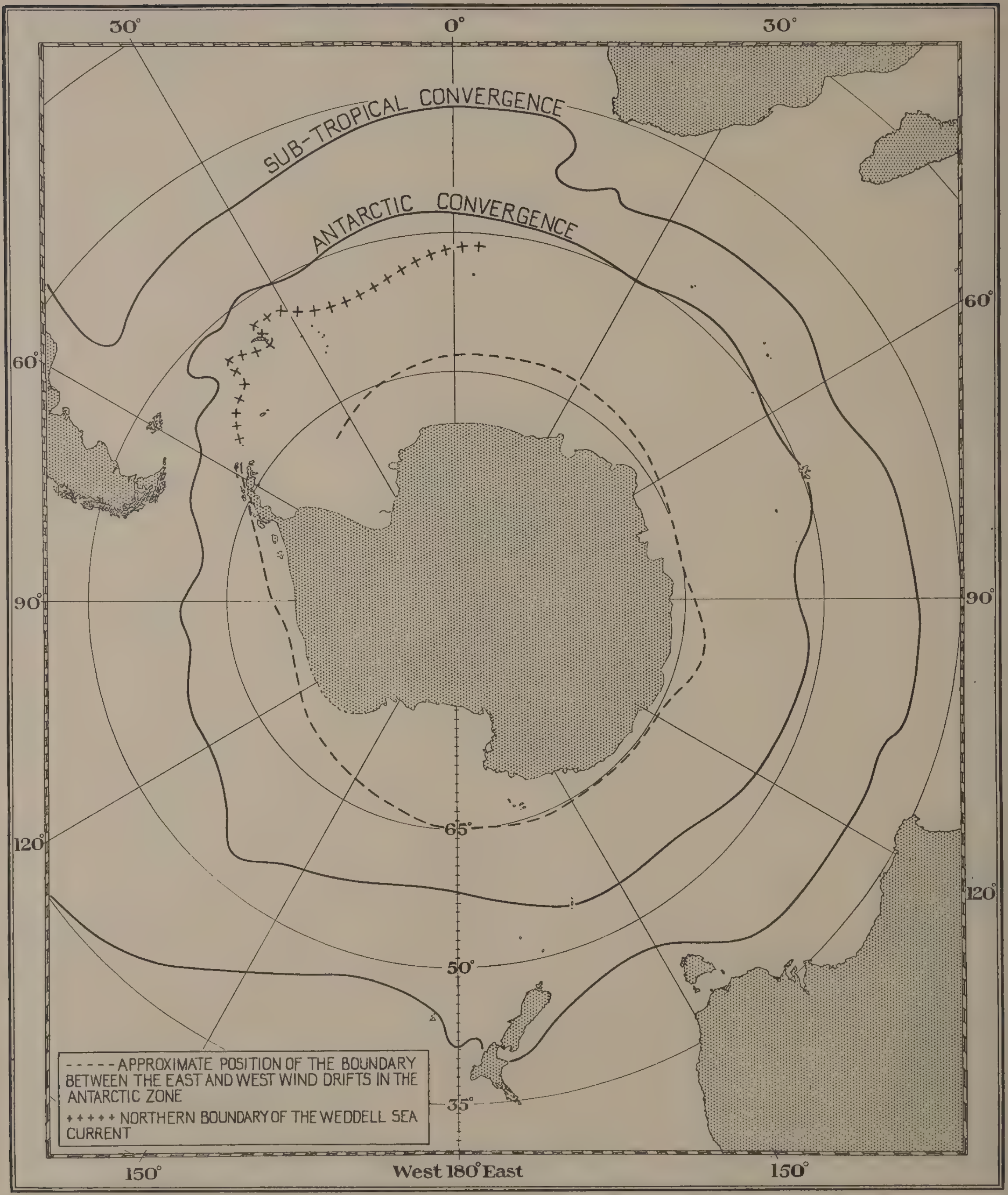
30°
0°
30°
SUB-TROPICAL CONVERGENCE
ANTARCTIC CONVERGENCE
60°
60°
90°
90°
120°
120°
65°
50°
35°
150°
West 180° East
150°
- - - - - APPROXIMATE POSITION OF THE BOUNDARY BETWEEN THE EAST AND WEST WIND DRIFTS IN THE ANTARCTIC ZONE
+ + + + + NORTHERN BOUNDARY OF THE WEDDELL SEA CURRENT

Fig. 59. The Antarctic and subtropical convergences, the northern boundary of the Weddell Sea current, and the approximate position of the boundary between the East and West Wind Drifts. (After Deacon.)

Table I.

	ANTARCTIC ZONE														SUB-ANTARCTIC ZONE	
	Glacial District									Kerguelen-Macquarie District						
	Ross Quadrant	Victoria Quadrant	Enderby Quadrant	Weddell Quadrant	S. Shetlands	S. Orkneys	S. Sandwich	S. Georgia	Bouvet I.	Marion Is.	Crozets	Kerguelen	Heard I.	Macquarie I.	Patagonia	Antipodes
Notothenia squamifrons	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.
Notothenia kempi	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.
Notothenia larseni	.	.	.	×	×	×	×	×	×	.	.	.	.	.	.	.
Notothenia gibberifrons	.	.	.	×	×	×	×	×	.	.	.	.	.	.	.	.
Notothenia mizops	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.
Notothenia nudifrons	.	.	.	×	×	×	×	×	.	.	.	.	.	.	.	.
Notothenia acuta	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.
Notothenia angustifrons	.	.	.	.	.	.	×	×	.	.	.	.	.	.	.	.
Notothenia marionensis	.	.	.	.	.	.	.	.	.	×	.	.	.	.	.	.
Notothenia cyanobrancha	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.
Notothenia coriiceps	.	×	.	×	×	×	.	×	.	.	×	×	×	.	.	.
Notothenia rossii	.	.	.	.	×	×	.	×	.	.	.	×	.	×	.	.
Notothenia macrocephala	.	.	.	.	.	.	.	.	.	.	.	×	.	×	×	×
Notothenia colbecki	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	×
Trematomus newnesi	.	×	×	×	×	×	.	.	.	.	.	.	.	.	.	.
Trematomus nicolai	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trematomus borchgrevinki	.	×	.	×	.	×	.	.	.	.	.	.	.	.	.	.
Trematomus brachysoma	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trematomus bernacchii	.	×	×	×	×	×	.	.	.	.	.	.	.	.	.	.
Trematomus vicarius	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.
Trematomus hansoni	.	×	×	×	×	×	.	×	.	.	.	.	.	.	.	.
Trematomus loennbergii	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.
Trematomus pennellii	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trematomus centronotus	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trematomus scotti	×	×	×	×	×	.	.	.	.	.	.	.	.	.	.	.
Trematomus lepidorhinus	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.
Trematomus eulepidotus	.	×	×	×	.	×	.	.	.	.	.	.	.	.	.	.
Dissostichus mawsoni	.	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.
Pleuragramma antarcticum	.	×	×	×	×	.	.	.	.	.	.	.	.	.	.	.
Artedidraco mirus	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.
Artedidraco orianae	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artedidraco skottsbergi	.	×	×	×	×	.	.	.	.	.	.	.	.	.	.	.
Artedidraco loennbergi	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.
Artedidraco shackletoni	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.
Dolloidraco longedorsalis	×	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.
Histiodraco velifer	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.
Pogonophryne scotti	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pogonophryne marmoratus	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.
Harpagifer bispinis	.	.	.	×	×	×	.	×	.	×	×	×	.	×	×	.
Bathydraco antarcticus	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bathydraco marri	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bathydraco macrolepis	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bathydraco scotiae	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.
Bathydraco nudiceps	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gerlachea australis	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.
Racovitzia glacialis	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.
Racovitzia harrissoni	.	×	×	×	.	.	.	.	.	.	.	.	.	.	.	.
Prionodraco evansii	.	×	×	.	.	×	.	.	.	.	.	.	.	.	.	.
Cygnodraco mawsoni	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.
Parachaenichthys georgianus	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.
Parachaenichthys charcoti	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.
Psilodraco breviceps	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.
Gymnodraco acuticeps	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Champsocephalus gunnari	.	.	.	.	.	.	.	×	.	.	.	×	.	.	.	.
Pagetopsis macropterus	.	×	×	×	.	.	.	.	.	.	.	.	.	.	.	.
Pseudochaenichthys georgianus	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.
Dacodraco hunteri	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chaenichthys rhinoceratus	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.
Chaenichthys rugosus	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.	.
Chaenocephalus aceratus	.	.	.	×	×	.	.	×	.	.	.	.	.	.	.	.
Cryodraco antarcticus	.	×	×	×	.	×	.	.	.	.	.	.	.	.	.	.
Cryodraco pappenheimi	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chionodraco kathleenae	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.
Chionodraco hamatus	.	.	.	×	×	.	.	.	.	.	.	.	.	.	.	.
Chaenodraco wilsoni	.	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.

It will be seen that the "*tessellata*" group, so characteristic of the Patagonian Region, is altogether wanting in the Antarctic Zone. Another interesting fact clearly shown by this table as well as by the map (Plate I) is that, although the genus *Notothenia* is well represented by six species on the coasts of Graham Land and at the neighbouring South Shetlands, it is represented in the Victoria Quadrant of the Antarctic Continent only by *N. coriiceps*, and has not been found at all in the Enderby and Ross Quadrants. It may be noted that *N. coriiceps* is probably not so demersal or littoral in its habits as many other species of the genus, and the silvery young may be mainly pelagic. From Graham Land species of *Notothenia* spread eastwards to the South Orkneys, South Sandwich Islands, South Georgia and Bouvet Island in the Glacial District, and other species occur in the Kerguelen-Macquarie District. In contrast to *Notothenia*, the genus *Trematomus* occurs in all four quadrants of the Antarctic Continent, extending northwards in the Weddell Quadrant to the South Orkneys and South Georgia, but not reaching Bouvet Island; it is absent altogether in the Kerguelen-Macquarie District.

With regard to the Zoarcidae, the group next in importance to the Nototheniiformes, I have little to add to the remarks on their distribution made by Regan (*t.c.*, pp. 31–33). Two of the Antarctic species are the southern representatives of the northern deep-water genera *Lycenchelys* and *Melanostigma*: *Melanostigma gelatinosum* is found in both Antarctic and Subantarctic Zones. The remainder are all generically distinct from the northern members of the family. The two genera *Lycodichthys* and *Austrolycichthys* (the first monotypic, the second with three species) are peculiar to the Antarctic and are confined to the Glacial District.

THE ANTARCTIC ZONE[1]

This includes the coasts of the Antarctic Continent and all the islands lying on or to the south of the Antarctic Convergence (fig. 59).

To quote Regan (*t.c.*, p. 33), "it is characterised by the complete absence of South Temperate types, by the absence of Bovichthyidae [the most generalised family of Nototheniiformes] and by the great development of other Nototheniiformes". The percentage of genera peculiar to this region is high (about 67 per cent), and the percentage of peculiar Nototheniiform genera very high (85 per cent). The percentage of species ranging beyond the limits of the Antarctic Zone is very low indeed (less than 10 per cent).

Glacial District

This includes the coasts of the Antarctic Continent and neighbouring islands, together with South Georgia, the South Sandwich Islands, and Bouvet Island, all found within the extreme limit of pack-ice.

NOTOTHENIIDAE. *Notothenia* (7 species); *Trematomus* (13 species); *Dissostichus* (1 species); *Pleuragramma* (1 species).

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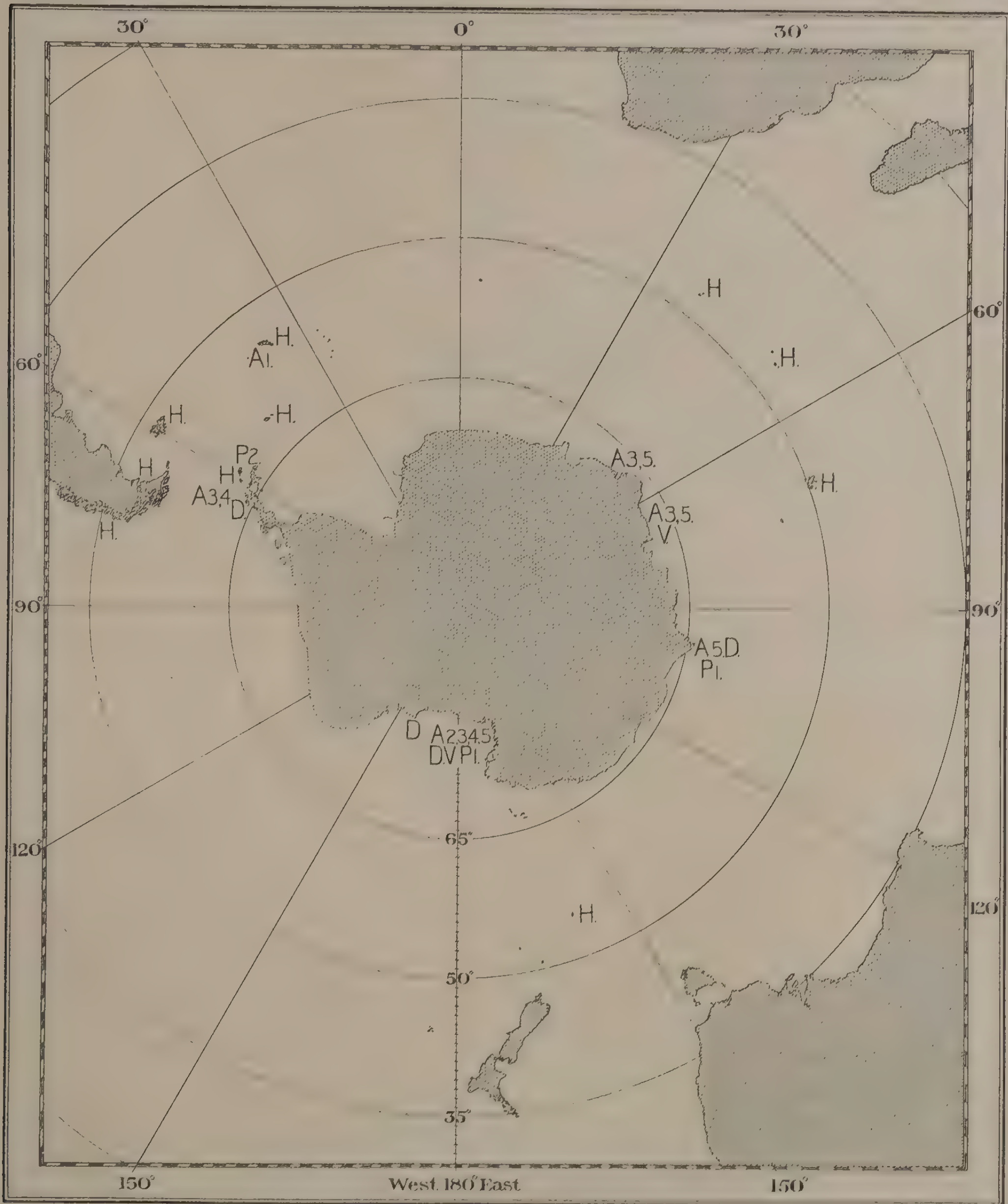
[1] The data which follow are arranged exactly as in Regan's report (1914*b*, p. 33) to facilitate ready reference and comparison.

Trematomus and *Pleuragramma* are restricted to this district, and of the 7 species of *Notothenia*, 5 are peculiar, only *N. coriiceps* and *N. rossii* ranging to the Kerguelen-Macquarie District. *N. angustifrons* is confined to South Georgia and the South Sandwich Islands. *Dissostichus* is represented by *D. mawsoni* in this district, and there is one other species (*D. eleginoides*) in the Patagonian Region of the Subantarctic Zone.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P2
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A3,5.
A3,5.
V
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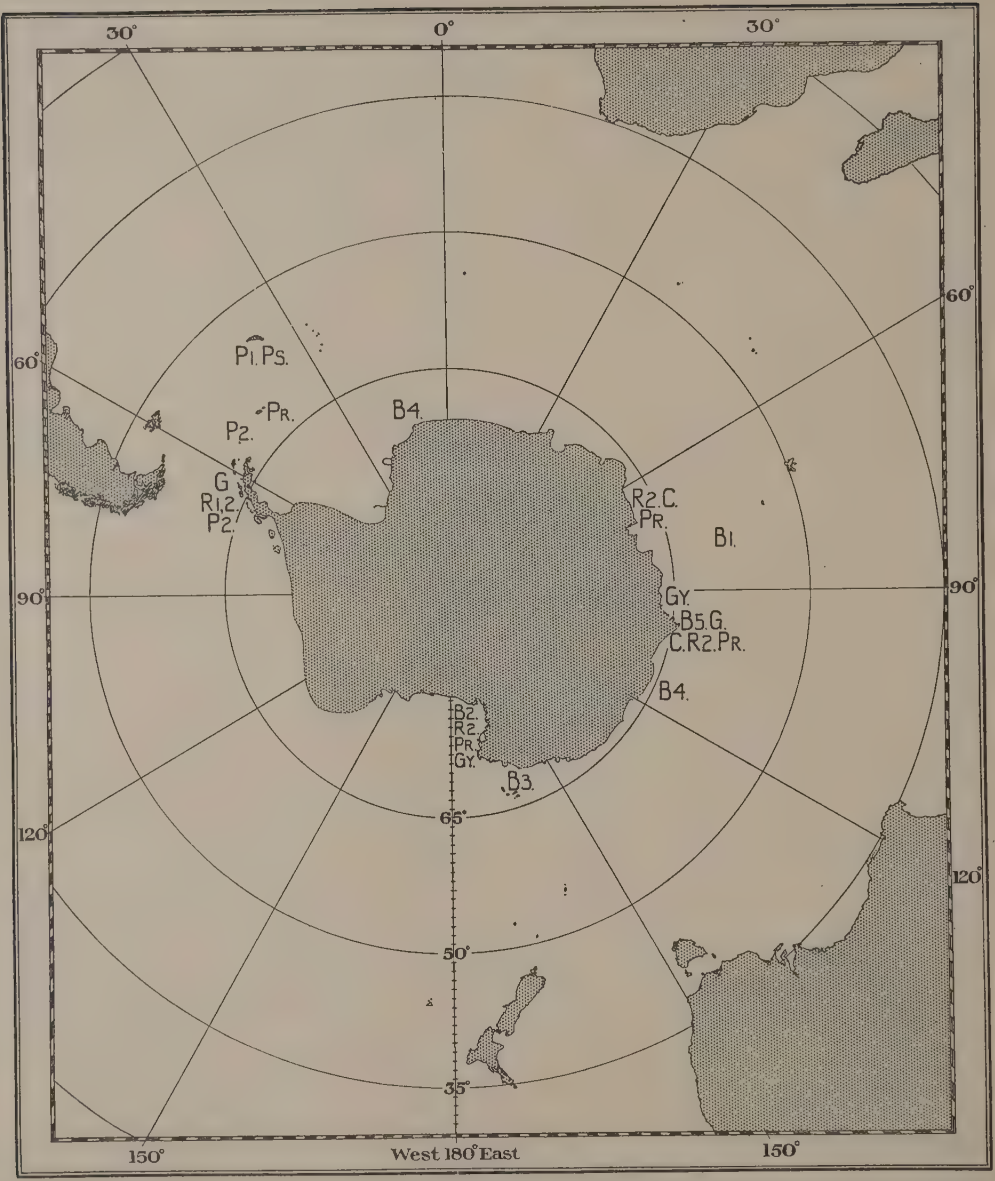
90°
90°
A5D
P1.
D
A2345
DVP1.
120°
65°
120°
H.
50°
35°
150°
West 180° East
150°

Fig. 60. Known distribution of Harpagiferidae. A 1, *Artedidraco mirus*; A 2, *A. orianae*; A 3, *A. skottsbergi*; A 4, *A. loennbergi*; A 5, *A. shackletoni*; D, *Dolloidraco longedorsalis*; V, *Histiodraco velifer*; P 1, *Pogonophryne scotti*; P 2, *P. marmoratus*; H, *Harpagifer bispinis*.


30°
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P1. Ps.
Pr.
P2.
G
R1,2.
P2.
B4.
R2. C.
Pr.
B1.
Gy.
B5. G.
C. R2. Pr.
B4.
B2.
R2.
Pr.
Gy.
B3.

Fig. 61. Known distribution of Bathydraconidae. B 1, *Bathydraco antarcticus*; B 2, *B. marri*; B 3, *B. macrolepis*; B 4, *B. scotiae*; B 5, *B. nudiceps*; G, *Gerlachea australis*; R 1, *Racovitzia glacialis*; R 2, *R. harrissoni*; Pr, *Prionodraco evansii*; C, *Cygnodraco mawsoni*; P 1, *Parachaenichthys georgianus*; P 2, *P. charcoti*; Ps, *Psilodraco breviceps*; Gy, *Gymnodraco acuticeps*.

HARPAGIFERIDAE. *Artedidraco* (5 species); *Dolloidraco* (1 species); *Histiodraco* (1 species); *Pogonophryne* (2 species); *Harpagifer* (1 species).

With the sole exception of *Harpagifer bispinis*, which occurs also in the Kerguelen-Macquarie District, as well as in the Patagonian Region of the Subantarctic Zone, all the genera and species of this family are peculiar to the Glacial District.

BATHYDRACONIDAE. *Bathydraco* (5 species); *Gerlachea* (1 species); *Racovitzia* (2 species); *Prionodraco* (1 species); *Cygnodraco* (1 species); *Parachaenichthys* (2 species); *Psilodraco* (1 species); *Gymnodraco* (1 species).

All the members of this family are confined to the Glacial District. According to Regan (*t.c.*, p. 33), *Bathydraco* must be regarded as oceanic, but, in spite of their being taken mainly in deep water, it seems likely that the related genera *Gerlachea*, *Racovitzia*, and perhaps *Prionodraco*, should be reckoned as coast fishes. None of the specimens of *Bathydraco*, however, has been captured far from the coast of the Antarctic Continent. *Cygnodraco*, *Parachaenichthys*, *Psilodraco* and *Gymnodraco* are clearly to be looked upon as coast fishes.

CHAENICHTHYIDAE. *Champsocephalus* (1 species); *Pagetopsis* (1 species); *Pseudochaenichthys* (1 species); *Dacodraco* (1 species); *Chaenocephalus* (1 species); *Cryodraco* (2 species); *Chionodraco* (2 species); *Chaenodraco* (1 species).

The members of this family are highly characteristic of the Glacial District, only three species being found outside the area. Of these, the two species of *Chaenichthys* are confined to Kerguelen, and the second species of *Champsocephalus*, *C. esox*, occurs in the Patagonian Region of the Subantarctic Zone.

ZOARCIDAE. *Lycenchelys* (1 species); *Lycodichthys* (1 species); *Austrolycichthys* (3 species); *Melanostigma* (1 species).

The species of *Maynea* from South Georgia mentioned by Regan (*t.c.*, p. 34) must be removed from the list of Southern Zoarcidae (see footnote on p. 81). The species of *Melanostigma* is found also in the Subantarctic Zone. The four species of Zoarcidae from the Antarctic Continent belong to two peculiar genera, *Lycodichthys* and *Austrolycichthys*, related to the Patagonian genera *Iluocoetes* and *Austrolycus* respectively.

MURAENOLEPIDAE. This family includes a single genus, of which four species have now been described, one from the Patagonian Region, one from Kerguelen, and two from the Glacial District. One of these last (*M. microps*) has also been recorded from the neighbourhood of the Burdwood Bank, just north of the Antarctic Convergence, and, thus, outside the Antarctic Zone.

The additional collections obtained since the publication of Regan's report (1914*b*) have increased the number of species known to have a circumpolar distribution, but our knowledge of the range of many species in the Glacial District is still far too incomplete to make possible any subdivision of this area. Of the 6 species of *Notothenia* occurring on the coasts of Antarctica, only one (*N. coriiceps*) has a circumpolar distribution, whereas, of the 12 species of *Trematomus*, 7 have been recorded from both the Weddell and Victoria Quadrants. *Pleuragramma antarcticum* and *Dissostichus mawsoni* are likewise known to be circumpolar. Of the Harpagiferidae, 3 out of

9 species are known from both sides of the Antarctic, of the Bathydraconidae, 3 out of 12 species, and of the Chaenichthyidae, 2 out of 8 species.

As Regan has pointed out (*t.c.*, p. 36), the affinities of the Nototheniiform fishes found at South Georgia are predominantly Glacial, and the presence of *Notothenia larseni* near Bouvet Island suggests that this island is also rightly included within this area.

Kerguelen-Macquarie District

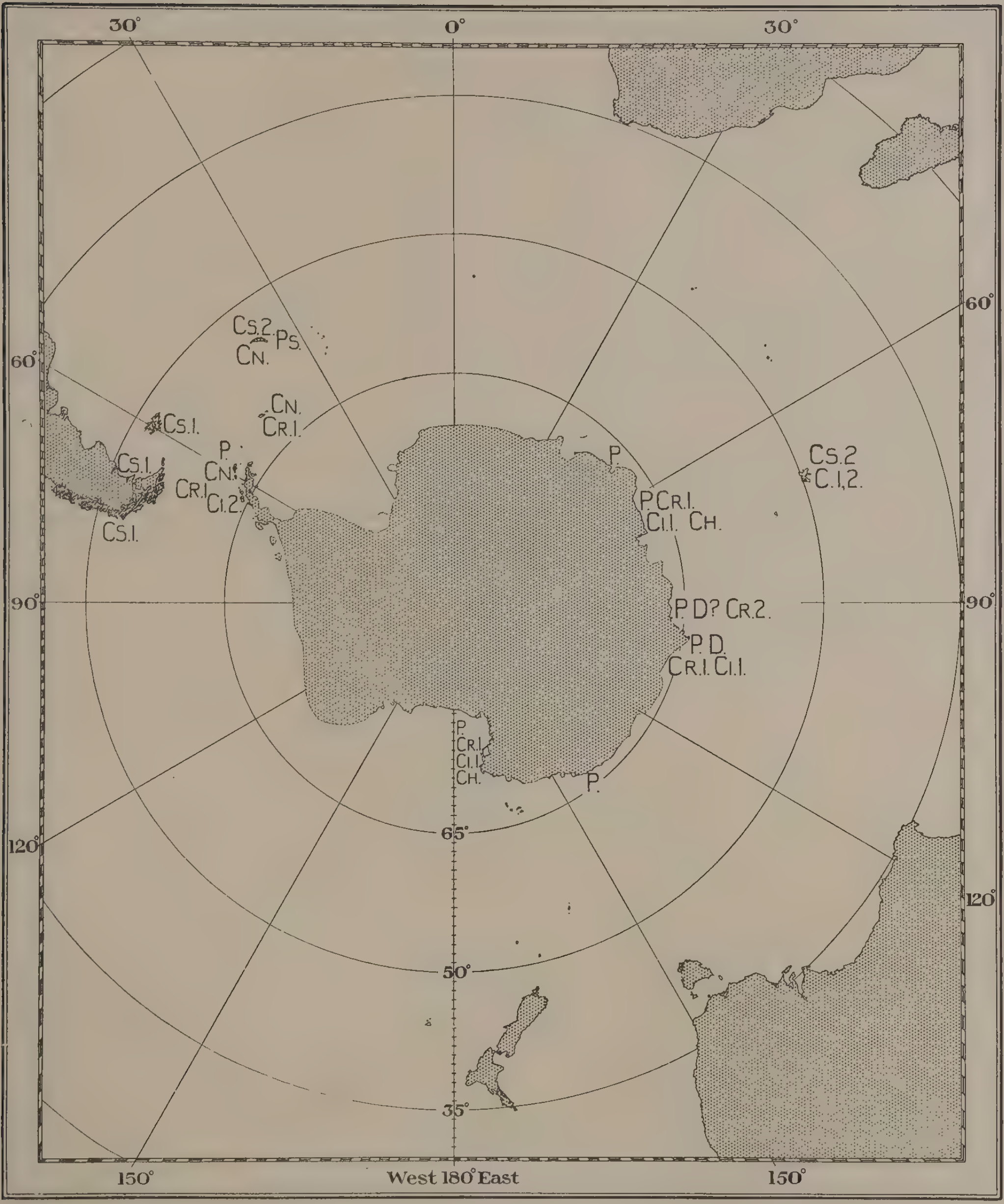
This district includes Marion and Prince Edward Islands, the Crozets, Kerguelen, Heard Island, and Macquarie Island. I have dealt with the fish-fauna in some detail in my report on the fishes obtained by the B.A.N.Z. Antarctic Research Expedition, but it may be of interest to summarize the conclusions here. The following table shows the distribution of the species of coastal fishes so far recorded from this district:

Table II.

	Kerguelen	Macquarie	Antipodes	Patagonia	S. Georgia	Antarctic	
Raja eatonii	×	.	.	.	.	.	Related to *R. scaphiops* (Patagonia)
Raja murrayi	×	.	.	.	.	.	Related to *R. macloviana* (Patagonia)
Muraenolepis marmoratus	×	.	.	.	.	.	Related to *M. microps* (mainly Antarctic)
Notothenia squamifrons	×	.	.	.	.	.	Related to *N. macrophthalma* (Birdwood Bank) and *N. larsoni* (Antarctic)
Notothenia mizops	×	.	.	.	.	.	Related to *N. nudifrons* (Antarctic)
Notothenia acuta	×	.	.	.	.	.	Related to *N. angustifrons* (Antarctic)
Notothenia marionensis	×	.	.	.	.	.	Related to *N. angustifrons* (Antarctic)
Notothenia cyanobrancha	×	.	.	.	.	.	Related to *N. coriiceps* (Antarctic)
Notothenia coriiceps	×	.	.	.	×	×	
Notothenia rossii	×	×	.	.	×	×	
Notothenia macrocephala	×	×	×	×	.	.	
Notothenia colbecki	.	×	×	.	.	.	
Harpagifer bispinis	×	×	.	×	×	×	
Champsocephalus gunnari	×	.	.	.	×	.	*C. esox* occurs in Patagonia
Chaenichthys rhinoceratus	×	.	.	.	.	.	
Chaenichthys rugosus	×	.	.	.	.	.	
Zanclorhynchus spinifer	×	×	.	.	.	.	
Mancopsetta maculata	×	.	.	×	×	.	

It is clear that, although the coastal fish-fauna of this district shows certain features of resemblance to that of the Patagonian Region and the Antipodes, its affinities are mainly with that of Antarctica.

Of the Nototheniiform fishes, the characteristic Antarctic genus, *Trematomus*, is absent from the Kerguelen-Macquarie District, but in the genus *Notothenia* the "*tessellata*" group so characteristic of the Patagonian Region is also wanting. Five species of *Notothenia* are peculiar to the district, all of which appear to be most nearly related to species occurring in the Glacial District, and mostly to species characteristic of the Weddell Quadrant. Of the remaining species, *N. coriiceps* and *N. rossii* are found elsewhere only in the Glacial District. *N. macrocephala*, however, occurs in both the Patagonian Region and the Antipodes, but not in the Antarctic, and *N. colbecki* in the Antipodes. *Harpagifer bispinis* occurs in the Patagonian Region as well as in the Glacial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Cs.1.
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Ci.2.
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P.
Cs.2
C.1,2.
P. Cr.1.
Ci.1. Ch.
90°
90°
P. D? Cr.2.
P. D.
Cr.1. Ci.1.
P.
Cr.1.
Ci.1.
Ch.
P.
65°
120°
120°
50°
35°
150°
West 180° East
150°

Fig. 62. Known distribution of Chaenichthyidae. Cs. 1, *Champsocephalus esox*; Cs. 2, *C. gunnari*; P, *Pagetopsis macropterus*; Ps, *Pseudochaenichthys georgianus*; D, *Dacodraco hunteri*; C. 1, *Chaenichthys rhinoceratus*; C. 2, *C. rugosus*; Cn, *Chaenocephalus aceratus*; Cr. 1, *Cryodraco antarcticus*; Cr. 2, *C. pappenheimi*; Ci. 1, *Chionodraco kathleenae*; Ci. 2, *C. hamatus*; Ch, *Chaenodraco wilsoni*.

District. *Champsocephalus gunnari* is found also at South Georgia, and a related species, *C. esox*, in the Patagonian Region. *Chaenichthys* (with two species) is a genus peculiar to the island of Kerguelen, but belongs to a family, most of the members of which occur in the Glacial District.

Thus, the only way to show the dissimilarity of the fish-fauna of the Kerguelen-Macquarie District from those of the Patagonian Region and the Antipodes, and to express its affinity to that of Antarctica, is to include it in the Antarctic Zone as a separate district (Regan, 1914*b*, p. 36).

I do not propose to discuss the question of the origin of the Antarctic fish-fauna in this report, and have nothing to add to the general conclusions of Regan (*t.c.*, p. 40). As he points out, "the distinctive features of the fish-fauna...are that nearly all the genera and species are peculiar and that they nearly all belong to a single group, the Nototheniiformes, which is characteristic of and almost restricted to the Antarctic and Subantarctic Zones. In the Antarctic Zone this group has developed into a large number of types that differ greatly in structure, appearance and habits. These facts seem to point to the conclusions that Antarctica may have long been isolated and that its coasts may have been washed by a cold sea for a long time, probably throughout the Tertiary Period." Regan has also shown that neither the fresh-water fishes, nor the marine fishes, whether Antarctic or South Temperate, support the theory that the Antarctic Continent connected South America with Australia during the Tertiary Period.

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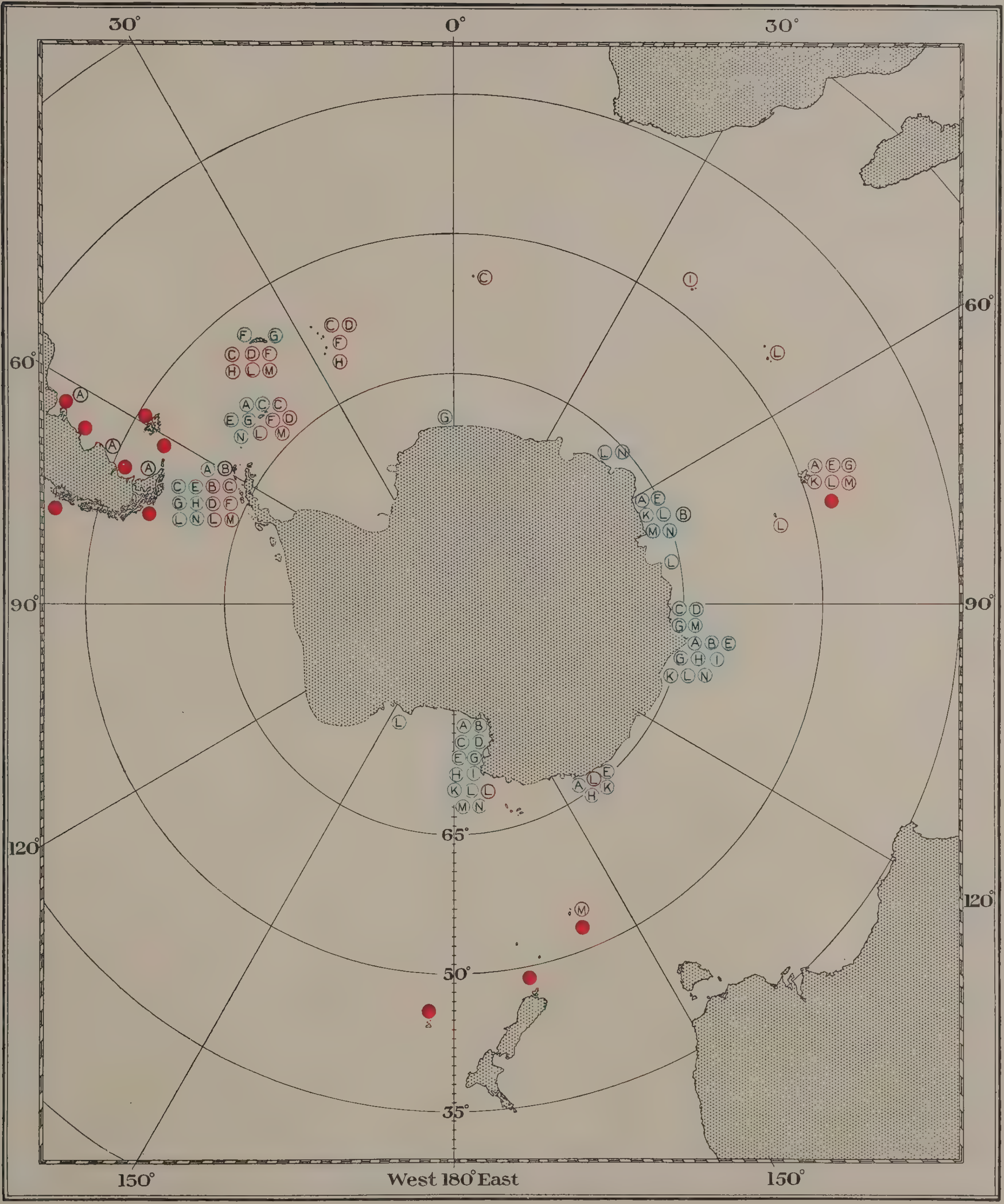
PLATE I

Known distribution of *Notothenia* (red), *Trematomus* (blue) and *Dissostichus* (black).

A, *Notothenia squamifrons*; B, *N. kempi*; C, *N. larseni*; D, *N. gibberifrons*; E, *N. mizops*; F, *N. nudifrons*; G, *N. acuta*; H, *N. angustifrons*; I, *N. marionensis*; K, *N. cyanobrancha*; L, *N. coriiceps*; M, *N. rossii*. The plain red circles show the known range of the Subantarctic species of *Notothenia*.

A, *Trematomus newnesi*; B, *T. nicolai*; C, *T. borchgrevinki*; D, *T. brachysoma*; E, *T. bernacchii*; F, *T. vicarius*; G, *T. hansoni*; H, *T. loennbergii*; I, *T. pennellii*; K, *T. centronotus*; L, *T. scotti*; M, *T. lepidorhinus*; N, *T. eulepidotus*.

A, *Dissostichus eleginoides*; B, *D. mawsoni*.


30°
0°
30°
60°
60°
90°
90°
120°
120°
65°
50°
35°
150°
West 180° East
150°

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[*Discovery Reports. Vol. XVIII, pp.* 105–120, *Plate II, August*, 1938.]

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INVESTIGATIONS

ON THE OPERATION OF LARGE PLANKTON NETS

By

JAMES W. S. MARR, M.A., B.Sc.

ON THE OPERATION OF LARGE PLANKTON NETS

By James W. S. Marr, M.A., B.Sc.

(Plate II; Text-figs. 1–4)

For the exploration of the deeper layers of the sea and the capture of the bigger and more active pelagic animals such as fishes, squids and the larger decapod Crustacea, which through their strength and speed can readily elude the ordinary tow-net, a net of exceptional size is necessary. The larger the apparatus the better, especially if investigations are to be made in deep water, for there are many indications that the ocean depths, while predominantly the haunt of relatively large and swiftly-moving creatures, are on the whole more thinly populated than the upper layers, so that the chances of their successful exploitation by ordinary nets are inclined to be small. However large the net may be it must be possible to close it, otherwise it can only be assumed, and, as will be shown later, assumed on inadequate grounds, that the species captured were taken from the particular level at which the net was fishing and not during its ascent to the surface.

Although large plankton nets have for long been in general use, until within comparatively recent years they were employed for the most part as simple open nets. The problem of closing them satisfactorily first appears to have received serious attention during the early days of the Discovery Committee's work when, between 1925 and 1927, closing experiments with several types of large mid-water net were conducted from the auxiliary barque 'Discovery' and formed an important part of her scientific programme. These experiments were concerned chiefly with two types of net—one a pelagic trawl of the well-known Petersen young-fish type, the other a tow-net of graded mesh, 60 ft. long and mounted on a ring 450 cm. (nearly 15 ft.) in diameter. The latter, usually referred to as the $4\frac{1}{2}$ m. net, or N 450, is believed to be the largest plankton net that has yet been fished. A third net, also of graded mesh and very similar in design to the N 450 but with an opening of 200 cm. diameter, was used for some time in the 'Discovery'; but after a short trial it was discarded in favour of the all-stramin pelagic trawl, which, mounted on a 200 cm. frame and used as an ordinary tow-net, proved in many ways a more efficient apparatus, and, being of stouter construction, better suited to the boisterous conditions of the Southern Ocean.

The dimensions and structural details of the N 450 are shown in Fig. 1. Since the first description of this net was published one important structural alteration has been made. As recommended by Kemp,[1] the longitudinal support roping (Fig. 1, *g*), originally of stout log-line and later of soft 2 in. circumference tarred hemp known in Admiralty dockyards as "Rumbo", has been replaced by a flat braided sennet, or webbing, of exceptional strength. This material has given every satisfaction, never taking turns in the water and interfering with the efficiency of the net as the "Rumbo" line was inclined to do.

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[1] Kemp, S., and Hardy, A. C., 1929, *Discovery Investigations: Objects, Equipment and Methods, Part II*, Discovery Reports, I, p. 187.

In the 'Discovery' experiments the N 450 was towed horizontally,[1] at that time the common practice with most if not all types of towed net, particularly those of larger size. Although it had worked well when fished open, yielding substantial catches in first-rate condition, as a closing net the N 450 met with little success. For closing, the familiar Nansen method was used, but even when all difficulties in the actual operation had eventually been overcome the results were never satisfactory: the volume of the catch was in most instances disappointingly small, the material often in poor condition and occasionally damaged so badly as to defy identification.

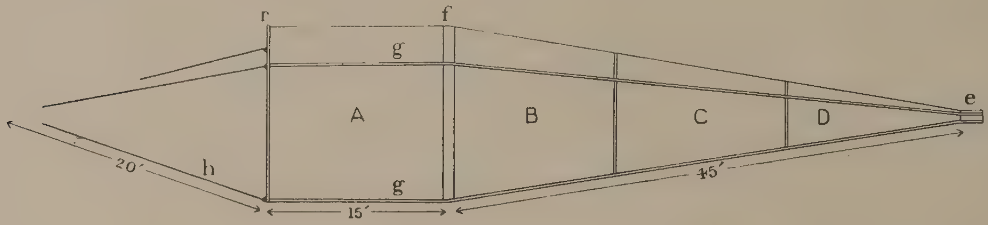

Fig. 1. Plan of 4½ m. net showing principal measurements and main structural features (after Kemp and Hardy). *A*, cylindrical non-catching part of 1½ in. mesh netting, 50 ft. in circumference. *BCD*, conical catching part tapering to a circumference of 3 ft. at *e*, with meshing as follows: *B*, ½ in., *C*, 7 mm., *D*, 7 mm., lined at the cod-end with finer 4 mm. material. *e*, canvas cylinder to slip over bucket; *f*, canvas band; *g*, longitudinal webbing supports; *h*, bridles; *r*, net ring, 450 mm. in diameter, 50 ft. in circumference.

The curious poverty of material in the closing net gave rise to the somewhat disturbing view that a large proportion, perhaps the majority, of the animals captured in a big open net fished horizontally might be taken not from the restricted horizon at which the net was fishing, but during its ascent towards the surface when the speed of towing as a rule is augmented by hauling. In other words it began to be suspected that the N 450, big as it was, was not being towed fast enough to capture the strong and actively-moving species for which it was designed—it seemed exceedingly likely in fact that during the horizontal tow all but the weakest were contriving to make their escape from the net, if they were not indeed eluding it altogether. It was for this reason that in later experiments the old method of slow horizontal fishing was abandoned and the faster method of the oblique tow, which for some time had been employed to advantage with smaller nets, took its place.

The poor condition of the material is not surprising, for so large an apparatus when closed on the Nansen principle would appear to behave as Kemp has put it "like an illconstructed kite, the bucket lashing from side to side and causing serious damage to the contents". Such erratic movement is doubtless aggravated by the behaviour of the heavy iron ring, which, no longer towed squarely by the bridles or buoyed up and held in steady control by the open net, is free to surge about at random. But that is not all that may happen: if, for instance, the moment of closing should escape notice, so that there is some delay in hauling after the net has actually been closed, or if some hitch should occur while hauling necessitating a stoppage of the winch, there is danger of the collapsed net with its cumbrous unsupported frame sinking and fouling the warp. Such a possibility cannot be overlooked, for it has been seen time after time when working flights of small silk and stramin nets that, for all their lightness, they must be hauled at fair speed as soon as they are closed, otherwise in their collapsed and unbuoyed state the mere force of towing alone is not enough to keep them from sinking and getting round the warp. In view of its far greater bulk and weight a mishap of this nature is more liable to happen with the N 450 than with smaller nets, especially in a very deep haul when the exact moment of closing may readily pass undetected by those on deck.

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[1] At a speed which is stated to have been about 2 knots. See, however, p. 115.

Owing to the failure of the Nansen principle the original idea of employing the N 450 as a routine deep-water net was temporarily abandoned, and for a long time during the earlier voyages of the 'Discovery II' it was put only to rare and occasional service, mainly as an open net. During the fourth voyage of the 'Discovery II', however, in response to increasing demands for more accurate information regarding the depths frequented by the larger pelagic creatures, the various problems involved in working this large apparatus began again to receive attention.

The chief problem, that of closing, had already been brought much nearer solution as a result of experiments with the young-fish trawl conducted towards the end of the third voyage of the 'Discovery II'. The Nansen principle had been abandoned and a system of internal throttling introduced in which the heavy net ring was so effectively controlled that all possibility of surging after closing was eliminated. Under the new system, which was recently described by Mackintosh,[1] the throttling rope operates on the inside of the net and when the bridles are slipped the net falls back bodily until the fore part, tightly strangled, is drawn in a cone up through the mouth of the ring. The latter does not capsize and turn end on as it does in the Nansen method, but falls back fairly until arrested, still maintaining its original fishing position, by a stray line or preventer, one end of which is attached to the release gear and the other to the towing shackle at the apex of the bridles. Thus, after closing as before, the ring is held in steady control by the bridles from start to finish of the haul.

The length of stray line required, which is the distance the net must be allowed to fall back, depends on the circumference of the net at the point where it is to be throttled. If the throttling rope works as a running noose the net must be dropped a distance at least equal to the circumference at the point of closing. On the other hand if the throttling rope is arranged to work "on the bight" the distance need only be half

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[1] Mackintosh, N. A., and Ardley, R. A. B., 1936, *The Royal Research Ship 'Discovery II'*, Discovery Reports, XIII, pp. 100–101.

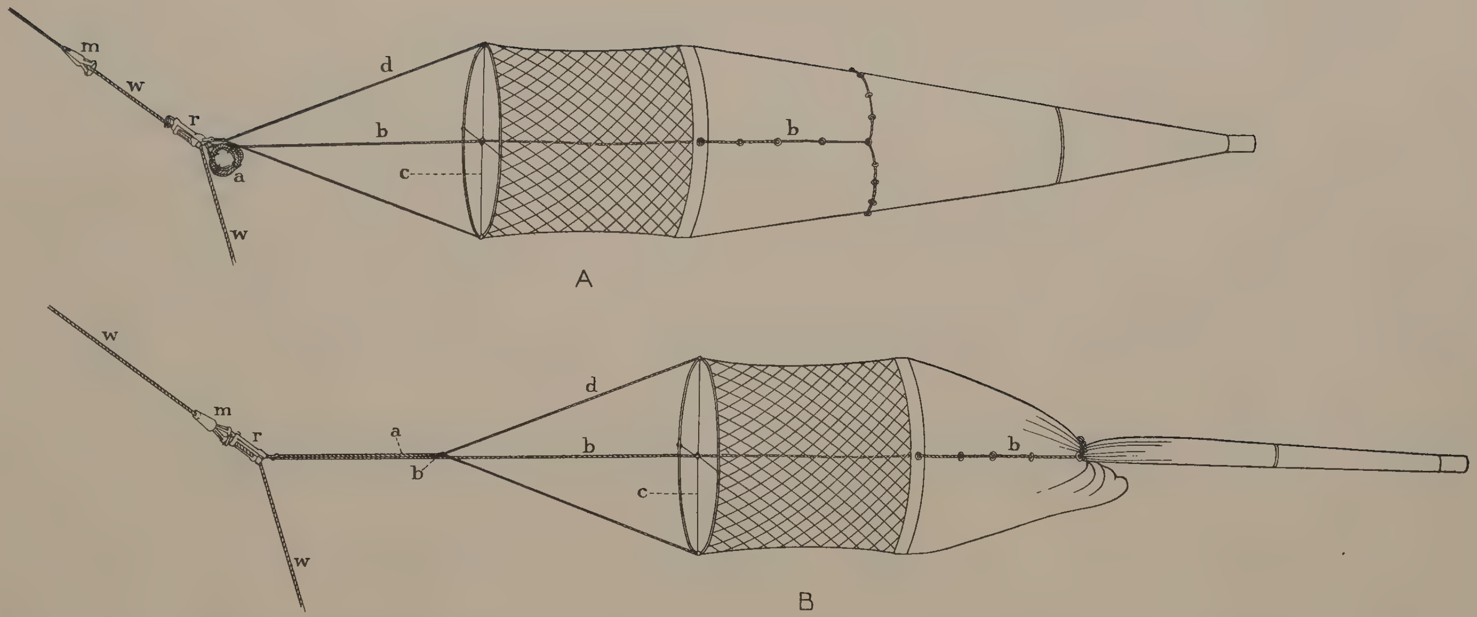

Fig. 2. Combination of Nansen and internal methods for closing very large nets (see also Fig. 3). *A*, the net open; *B*, the net closed. *a*, stray line; *b*, throttling rope; *c*, cross-wires stiffening net ring; *d*, bridles; *m*, messenger; *r*, closing mechanism; *w*, warp.

the circumference, although in practice, to make sure that the net is completely strangled, a somewhat longer drop is required. Equally effective throttling can be obtained by either arrangement, but of the two the second is much to be preferred, since with its shorter drop it is less inclined to strain the gear—a matter of major importance where heavy deep-sea apparatus is concerned.

Until it has come into play, that is while the net is still fishing, the stray line is coiled small behind the release gear and stopped off with sail twine, otherwise its loose bight might become involved in the twisting warp, or by fouling the closing mechanism precipitate release. The arrangement of the stray line is shown in Figs. 2 and 3.

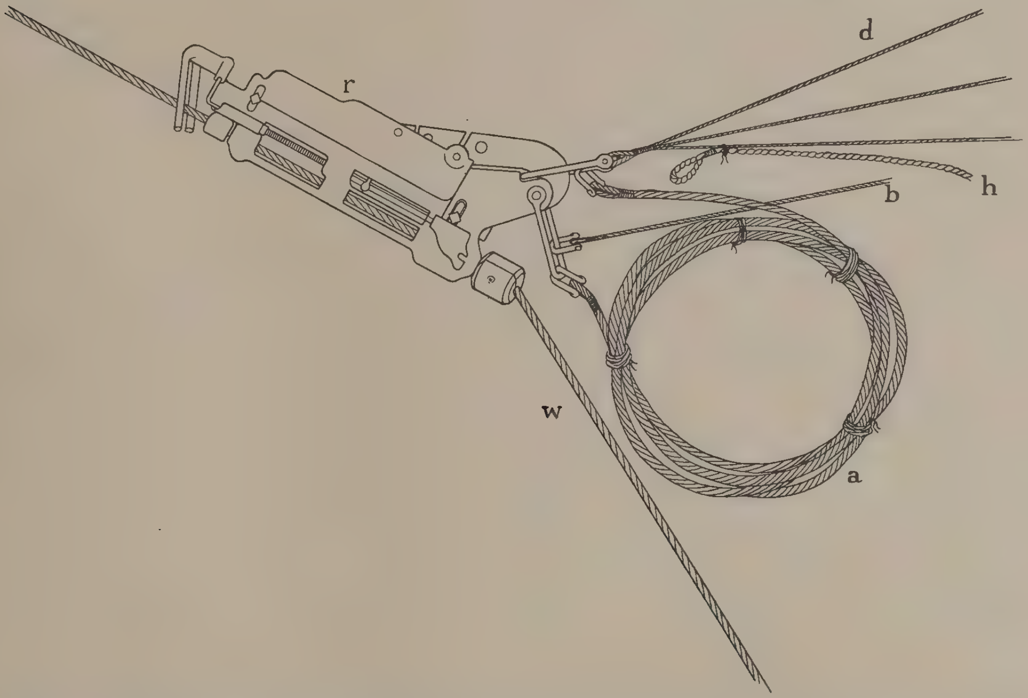

Fig. 3. Large closing nets: details of the arrangement of the gear behind the closing mechanism. *a*, stray line; *b*, throttling rope; *d*, bridles; *h*, hauling rope to net ring; *r*, closing mechanism; *w*, warp.

It is interesting to recall that an internal closing arrangement, acting in the opposite direction but essentially similar in principle to that which has just been described, had been employed by Kemp[1] some ten years previously for sending down large mid-water nets closed and opening them under water.

So far the new internal throttling arrangement had only been employed with the young-fish trawl, mounted as already described on a 2-metre ring: whether it could be applied as it stood to the much larger and heavier N 450 with an opening five times the area was a matter for some concern, for to close the N 450 as it would normally be closed, that is by throttling at the canvas band (Fig 1, *f*) where the circumference is 50 ft., a drop of at least 30 feet, and probably more, would be required. This was felt to be an undesirably long drop, the shock of which sooner or later might result in the collapse of the heavy frame, if not in the loss of the entire apparatus. With a view therefore to keeping the drop within reasonable limits it was eventually decided to throttle the net in the region of the narrow cod-end, at a point only 15 ft. away from the bucket. By closing at this point the backward fall of the net could be reduced to as little as 12 ft. There was another and equally important reason for choosing such an unusual closing position. With such an arrangement a large part of the net, the part forward of the closing point, must obviously continue to fish after throttling had taken place, and it was hoped that the steadying influence thereby exerted on the bucket behind would contribute materially towards preserving the catch from damage.

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[1] Kemp, S., *loc. cit.*, p. 202.

To allow such a large apparatus to fall back open and then to arrest it, still fishing, in its backward path, would it was realized tax the gear severely; by the sudden jerk bridles and stray line in particular would be put to an unusually severe test, while the unwieldy ring might well be strained to the point of collapse. To provide against mishap the heavy ring, which if suspended in air from a single point is inclined to buckle under its own weight, was specially stiffened by the introduction of a system of four thin steel wires stretched taut across the mouth of the frame, radiating in the form of a cross from a small steel ring in the centre which was to act as a fair-lead for the closing rope (Fig. 2, *c*, and Plate II). For the cross-wires the ordinary 4 mm. diameter plankton wire was used. It is of exceptional strength but small enough not to cause any serious obstruction in the mouth of the net. Further protection against buckling was provided by employing six bridles of 6 mm. diameter wire instead of the usual four. Obstruction in the mouth of a tow-net, especially that caused by bridles, should of course be reduced wherever possible, and in this respect the efficiency of the N 450 would doubtless be increased by the introduction of a heavier frame than that at present in use; with a sufficiently rigid frame there would be no need for so many bridles—three would be enough—and at the same time it would be possible to dispense altogether with the stiffening cross-wires. For the stray line, on the strength of which so much would depend, $1\frac{7}{8}$ in. circumference wire was used, and a special preventer was provided, connecting the eye of the bridles with the after end of the stray line, in case the towing shackle, which is of rather light construction, should carry away when the whole weight of the fishing apparatus fell suddenly on to it.

These arrangements, although not altogether satisfactory at first, with gradual modification eventually achieved their purpose. With the throttling rope rigged to operate internally and so near the bucket, the fore part of the net, as anticipated, continued to fish after the narrow cod-end had been throttled. The net in consequence became a double-acting one, traversing in its path two distinct horizons—a lower prior to closing and an upper during its ascent to the surface—and yielding therefrom a catch in the bucket and another in the bag formed by the constriction of the net 15 ft. above. The condition of the material in the bucket, the major concern of the experiment, was excellent, there being no sign of the buffeting to which it had previously been subjected when the net was being closed by the Nansen method. Some of the animals, though taken below 1000 m., were brought to the surface alive and vigorous, a circumstance for which the steady fishing of the forward open end of the net, through controlling the collapsed portion behind, was doubtless largely responsible.

There was, however, a serious objection to the internal method of closing when applied so far down the net, for no matter how taut the throttling rope might be drawn a narrow passage would always be left in the constriction through which, it was strongly suspected, part of the catch in the fore part of the net was being carried by the pressure of water back into the bucket behind. This objection was overcome by adopting a closing arrangement which, while retaining the same throttling position 15 ft. away from the bucket, was a compromise between the internal and Nansen methods. The throttling rope, as before, was led inwards through the mouth of the net by way of the fair-lead on the cross-wires, then out again through a small hole in the canvas band, down through a series of rings sewn in one of the webbing supports, and so round the outside of the net. The throttling rope, originally of 1½ in. circumference manilla, was now replaced by a 6 mm. diameter wire—not for the sake of its strength, but because it renders so much more readily round the net than manilla. Thus rigged the net was paid away to a depth of about 1000 m., closed immediately, and hauled rapidly to the surface. The constriction was evidently a good one, blocking all access to the rear, for the whole of the catch was confined to the fore part of the net and the bucket was empty.

With the net in this rig a large number of closing hauls, both horizontal and oblique, were conducted without hitch at all depths between 3500 and 400 m. The new closing arrangement, however, simple as it was and thoroughly reliable mechanically, did not meet with complete success, for although the condition of the material in the bucket continued to maintain a consistently high standard, the actual quantity taken, as in the early experiments, was still far from satisfactory. More than once during these operations the bucket came back practically empty, and never under any circumstances—regardless that is to say of the speed, depth, or duration of the haul—was the catch more than a fraction of what would normally be expected in such a large apparatus. On the other hand the catch in the forward open section of the net was always substantially large, generally from ten to twenty times greater than that in the bucket behind. In view of the persistent failure to obtain satisfactory results a number of tests were carried out in which the throttling rope was moved successively farther away from the bucket, and as a result it was shown that the net was being throttled too far aft, part of the catch which ought to have found its way to the cod-end apparently being cut off to appear instead in the open section in front. The explanation of this is not quite clear, but it is possible among other things that the animals these nets are designed to capture, being big and powerful and exceedingly active swimmers, may contrive for a time at least to remain far forward in the net, especially if it is being towed slowly, with the result that if throttling takes place too far to the rear some of them may never reach the bucket.

In the arrangement finally adopted the net was throttled at a point half-way between the bucket and the ring and in this position large catches in first-rate condition were obtained in the bucket at all depths down to 2000 m. The modified net in its open and closed positions is shown in Fig. 2.

With the rope working externally, as described, this is probably the most suitable arrangement that can be contrived for closing such a large net. Where throttling now takes place the circumference of the net is 32 ft., and a drop of 20 ft., which is not unduly large, is required to effect a satisfactory constriction. There is still, after closing, 30 ft. of the forward coarse-meshed end to keep up the even fishing strain, and this not only steadies the collapsed portion tailing out a further 30 ft. astern, but is enough to "float" the heavy ring so that even with the winch stopped there is little fear of its sinking and fouling the warp. The net, of course, is still a double-acting one, yielding large catches in the $\frac{1}{2}$ in. netting of the forward section. In general condition the front section material is naturally somewhat inferior to that in the bucket, yet the bulk of it is in a very passable state.

The throttling rope it is true might be moved still farther up the net to operate at its normal position, the canvas band, but for various reasons such an arrangement might not prove altogether satisfactory. In the first place it would be necessary to fall back on an internal rope, and it is rather doubtful if the 50 ft. of material composing the canvas band could be constricted internally without leaving, as already explained, an undesirably large hiatus. Further, apart from the much longer drop that would be required, and the increased risk of straining the gear that this must entail, there would be greater difficulty after closing in controlling the heavy ring, unless it were being hove very fast, for the net behind, being completely collapsed, would no longer impart to it the necessary buoyancy.

In recent practice the faster oblique method of towing, in which the speed of the ship can be augmented by that of the winch, has superseded the horizontal. The importance of rapid fishing, already suspected, was established at an early stage in these experiments, when oblique nets travelling more quickly through the water, but covering comparatively little ground, produced consistently better results—bigger catches and larger individual animals—than horizontal tows of twice the duration. In spite of its advantage in speed, however, the oblique method has certain obvious limitations, for whereas a horizontal net can be towed indefinitely within the limits of the same restricted horizon, the oblique net, as long as it remains open, must unavoidably widen its horizon, slowly or rapidly according to the speed at which it is being hauled. At first sight therefore it would appear impossible with a fast-moving oblique net to examine a sufficiently narrow horizon without a drastic shortening of the haul—a serious disadvantage, especially when working in deep water, where, since the animal community is so widely scattered, the time of fishing should be as long as possible.

The tendency of a large fast-moving oblique net to rise through too wide a horizon can however be effectively controlled without unduly curtailing the actual period of the haul. At normal towing speeds of from 1 to $1\frac{1}{2}$ knots the N 450, if hauled obliquely, will rise through a vertical height approximating to half the amount of wire hove in. For example, if 2000 m. be hauled, the vertical ascent is likely to be in the neighbourhood of 1000 m. It is possible, however, hauling the same amount of warp, to fish a much narrower horizon than this if the speed of the ship be kept down to about half a knot while the net is coming in. With the ship moving so slowly ahead, the net, for lack of sufficient forward force to give it the necessary lift, is strongly inclined to sink—especially in deep water work when long lengths of wire up to several tons in weight are used—and this downward tendency, acting against the oblique upward pull, greatly reduces the angle of ascent, the horizon in consequence being kept within more reasonable limits. It is of course obvious that oblique fishing from a very slow-moving ship can only be carried out with fast-moving nets, travelling at speeds far in excess of normal, for the usual oblique hauling rate of 10 m. per min. is too slow to overcome the downward tendency of the warp and net, the latter in consequence sinking faster than it can rise.

In practice the speed of the ship is reduced as soon as the wire is all out, and hauling begins after a lapse of about a minute, or if necessary several minutes, when it has been ascertained from the steepening of the warp that the net has a strong downward tendency. When working in deep water, 2000 m. is hauled before closing, the rate of haul depending a good deal on the state of the weather. A maximum speed of 40 m. per min. has been reached in calm conditions, but as a rule the average rate is about 35 m. per min., a speed that can be maintained in winds up to force 3 or 4 without straining the gear. At this rate the net can be hauled for an hour, long enough to produce an ample quantity of material from the greatest depth at which the apparatus in its present form has so far been used. The horizon examined rarely exceeds 600 m., for deep-sea work not unduly wide, but with experience it can be kept down to as little as 500 m. or even less (see p. 117 and Fig. 4).

Although excellent results have been obtained by this new method of rapid oblique hauling the actual rate of fishing does not at first sight appear to have undergone any marked increase. At its fastest, that is, allowing 40 m. per min. for the net and two-thirds of a knot at most for the ship, it cannot be higher than 60 m. per min., or about 2 knots—no more in fact than the speed at which the net is stated to have been fished in the original horizontal experiments. The success that has attended the recent operations, however, and the repeated failure of the early horizontal closing hauls can only have one satisfactory explanation, that even at 2 knots the net travels more quickly now than it did in the past, when in all probability the horizontal speed was less than it is claimed to have been. It is impossible otherwise to account for the vastly increased efficiency of the net.

The increased catching power of the net is perhaps best illustrated by the presence in recent hauls of unusually large deep-sea forms, including among the pelagic prawns species of *Acanthephyra* 20 cm. long. So far it is true the occurrence of such forms has been rare, yet by employing still faster nets there is no reason why they should not be captured consistently, along with other and even larger animals which doubtless exist.

In oblique fishing, provided the ship is moving ahead slowly enough, practically the only limit to the rate of haul is the bursting point of the net itself. By further strengthening the gear therefore at all vulnerable points, and if necessary constructing the meshing of the net of stronger material, it should be possible to haul at speeds up to 70 or 80 m. per min., giving a total fishing speed of about 3 knots. The main objection to such a big increase in the oblique rate is that the time of fishing, already short enough, would have to be still further reduced; at a rate of 70 m. per min., hauling 2000 m. which is the most that can be hauled without interfering unduly with the vertical horizon, the fishing time would be barely half an hour. For this reason, then, high-speed horizontal towing, if it could be accomplished, would be preferable. Without much alteration of the existing gear, however, there seems to be little hope of obtaining any marked improvement in the present horizontal rate. A much heavier and stronger warp would certainly have to be used, and consequently a bigger and more powerful winch, for the strain of towing such a large net at 3 knots, in view of the enormous weight that would be required to keep it down, would probably be more than the existing warp could stand. In the original horizontal experiments a 100 lb. sinker was used at the end of the warp. If double that weight could be employed with safety no doubt some increase in horizontal speed could be obtained without resorting to a larger warp. At the same time various devices might be employed to improve the catching power of the net itself. Non-return pockets might be provided as in the commercial otter trawl, while, as already remarked, much of the existing obstruction in the mouth could be avoided by the introduction of a heavier and more rigid frame.

It might reasonably be objected that any further increase in the fishing rate will result in serious damage to the catch, but in view of the admirable condition of the material that has recently been captured there seems to be little ground for anxiety on this account. Slow fishing might well have a more detrimental effect, especially upon the larger and more vigorous animals, which in their efforts to escape from a slow-moving apparatus must no doubt suffer considerable damage through dashing themselves violently against the sides of the net. On the other hand in a net travelling at high speed even the most active species must tend to be swept rapidly back to the bucket, where, should they escape being stunned or killed outright, they must at least be rendered immobile.

Much of the recent experimental work could not have been undertaken without the help of a reliable depth gauge. The instrument now in use, the improved deep-water pattern described by Mackintosh,[1] has given excellent service throughout a long series of hauls extending down to 3500 m. From the records obtained it appears that when a large net is hauled rapidly from a slow-moving vessel it is inclined at first to move almost horizontally through the water when the downward tendency of the warp and net is more or less evenly balanced by the oblique upward force. As the haul progresses the angle of ascent becomes gradually more accentuated, but it is only in the latter stages shortly before closing is about to take place that the net begins to rise steeply.

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[1] Mackintosh, N. A., and Ardley, R. A. B., 1936, *loc. cit.*, p. 102.

In oblique work of this kind, where the vertical ascent of the net is inclined to vary considerably from one haul to another, it is most important that the exact depth of closing should be known. In recording this depth the depth gauge has proved indispensable, the shock of closing causing the pen to swing violently and so produce a vertical stroke on the paper across the line representing the path of the net.

One of the more recently obtained depth gauge charts illustrating the features described above is reproduced in Fig. 4. The chart represents the path of the N 450 during the operation of a deep-water haul in which 4000 m. of wire was paid away in all and 2000 m. hauled before closing. The path of the net while fishing is indicated by the letters *abc*, *a* being the point where fishing actually began, and *c* the closing point clearly shown by the vertical stroke of the pen. It will be seen that in this particular haul the net for more than half the time (from *a* to *b*) was travelling almost horizontally through the water. Another feature especially well illustrated in Fig. 4 is the remarkably narrow horizon that can sometimes be examined by these large oblique closing nets in spite of the great length of wire that is brought in. In this particular instance the depth gauge reading was 1950–1550 m., showing a vertical ascent for the net of only 400 m.

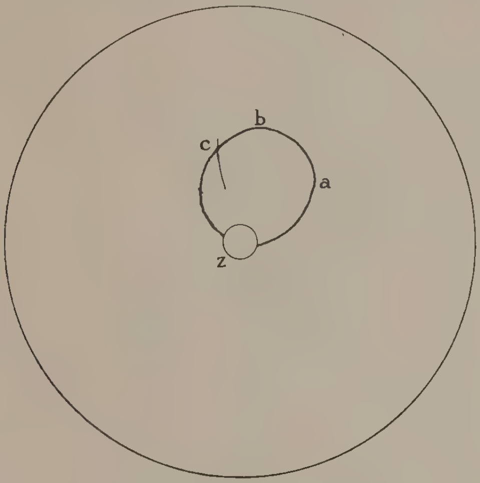


Fig. 4. Reproduction of a depth gauge chart showing the path of the N 450 during a 2000 m. oblique haul ($\frac{1}{2}$ actual size). *abc*, the path of the net while fishing; *c*, closing point; *z*, zero line. For further explanation see text.

In the 'Discovery II' the N 450 is worked over the stern through the fair-lead in the rail on the port side. When in daily service it is carried, ring uppermost, flat on the spacious poop, with the closing mechanism attached and the gear all clear for running —the stray line coiled and stopped off, the throttling wire carefully slacked away to ensure that the net will open to its full capacity on entering the water. When shooting, the weight[1] is attached to the end of the warp and 20 or 30 m. paid away. The warp, with the stop and heavy closing mechanism attached inboard, is now lifted out of the fair-lead with a snatch-block and tackle from the poop derrick plumbed directly overhead, and the gear is passed clear over the side and held fast about a foot abaft the rail. The wire is then slacked back into the fair-lead. In passing the gear over the rail the snatch-block is placed *in front* of the large mechanism, from which it must be backed well clear by means of a whip to the rigging, otherwise by riding down the warp it will come in contact with the apparatus and bring about a premature release. The derrick is now swung amidships and the frame, suspended from a slip-hook provided with a tripping line, is hoisted until it clears the rail when the bucket and net are put over and allowed to drift astern. When all is clear the frame is lowered to the water's edge and tripped, preferably when about three parts submerged to avoid an unnecessary jerk on the release. It helps greatly when shooting if the throttling wire and all six bridles be gathered together into a single bundle and the whole stopped off with a few turns of sail twine. This procedure is a safeguard against mishap as the bridles and wire, if flying about loose, are apt to foul the release while the frame is being lowered into the water. The stops, of course, part readily as soon as the strain comes on the bridles.

---

[1] No weight other than the depth gauge, which weighs nearly a hundredweight, is used.

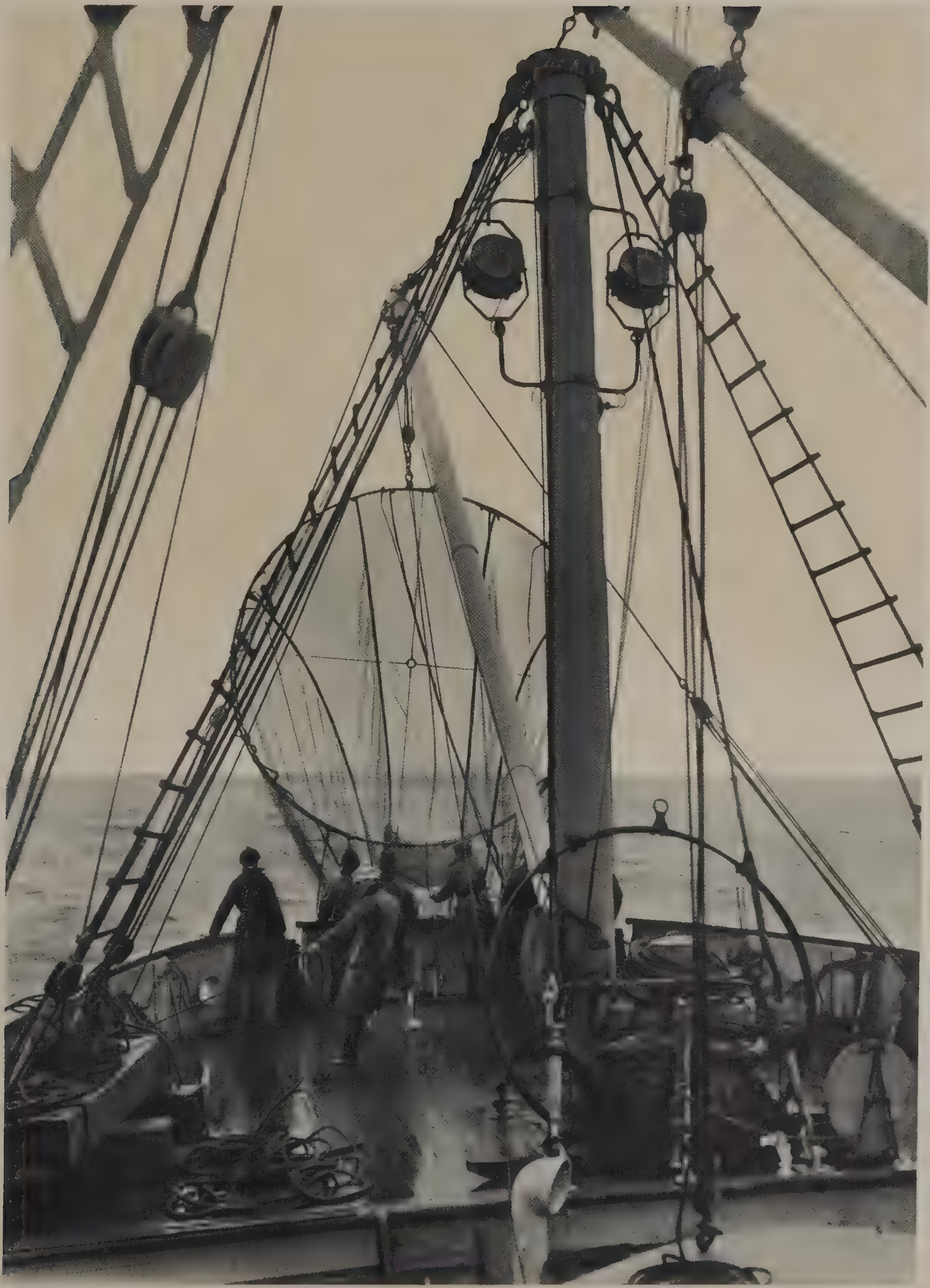
Throughout this operation the ship is kept moving very slowly ahead, at little more than half a knot, but as soon as the net has entered the water and is streaming well away speed is increased considerably and the warp allowed to run out as rapidly as possible. In a deep haul requiring 4000 or 5000 m. of wire the first 2000 m. as a rule is paid away at from 60 to 80 m. per min., the ship making from 2 to 3 knots. The remainder, however, is run out at an ever decreasing rate as the increasing load over the stern automatically retards the forward speed of the ship. Particular care must be taken in paying out the last 1000 and the last 500 m., for if then allowed to run out too fast, the wire, by virtue of its greatly increased total weight, may over-run the net, and, becoming slack, may kink or fly into a bight round the release. In shallow water work, when the time occupied in paying out is merely a matter of minutes, nets shot open catch next to nothing on the way down. Deep nets on the other hand, taking anything from an hour to an hour and a half to reach their required level, are naturally far more liable to error through fishing on the way out. It is therefore of the greatest importance that in practice they be paid away at a rate which as nearly as possible is just a fraction under that at which the ship is travelling.

When the wire is all out and the necessary reduction in the ship's forward speed has been made, hauling begins and is continued without a break to the surface, the messenger, as in vertical hauling, being despatched in time to meet and close the ascending net at the moment when the metre-recording dial shows that the required amount of warp has come in. The winch may be stopped for a few seconds while the messenger is being attached to the wire, but it is better not to do so, for even a momentary slackening of the fishing speed might be enough to allow the more active individuals in the catch to escape. In timing the despatch of the messenger allowance is made for its own speed and for the rate at which the net is approaching from below. At the steep warp angles employed in rapid oblique fishing the 22 lb. messenger in use travels about 2000 m.

PLATE II

Shooting the 4½ m. net. Note the stiffening wires stretched across the mouth of the frame and the central fair-lead to take the throttling wire.

At the time when this photograph was taken the net was not rigged for closing but was being used to tow a large and heavy tank specially designed for the capture of live pelagic fish by Prof. A. C. Hardy of Hull.



A Saunders phot

John Bale, Sons & Curnow, Ltd London.

THE 4½-METRE NET

in 10 min., the net, hauled at 40 m. per min., travelling 400 m. in the same time. Thus, if closing be desired on 2000 m. of wire, the messenger must be released at the surface when the recording dial reads 2400 m. Corresponding dial readings can be calculated for any length of wire and for any warp or messenger speed.

The moment of closing, even in deep water, can generally be detected on deck either by feeling the wire or by watching the drum of the winch which revolves for about a second at high speed as the net, falling back, momentarily ceases to fish. When it has been ascertained that the net is throttled, the open-meshed forward section only continuing to fish, the hauling rate may safely be increased to between 45 and 50 m. per min. It should not however be more.

When bringing the net on board the release gear, hauled slowly up to the rail, is stopped just outside the fair-lead, and when the warp has been raised as before, the large mechanism is hoisted on board with the winch. The warp, slacked back into the fair-lead, is now hove up until the eye of the hauling rope (Fig. 3, *h*), with which all large net rings are provided, can be cast adrift outboard, passed through the fair-lead, and hooked on to a light purchase on deck. With the help of the purchase the heavy frame is lifted out of the water and hauled close up to the rail when the large tackle can be hooked on and the frame hoisted to the derrick head. It is now a simple matter to get the net on board. While the frame is being hauled and hoisted the throttling wire must be brought in simultaneously, hand over hand, otherwise it will slack off and allow the catch in the fore section of the net to drop back and mingle with that in the bucket behind. For easier handling the wire is provided at its forward end with a "tail" of 1½ in. manilla.

Throughout the entire operation, while shooting, paying out and hauling, the ship from start to finish is kept dead before the wind. It is impossible in practice to work for long on any other course, for at the low forward speeds employed when hauling all steerage way is lost, and the ship, virtually anchored by the stern, is inclined all the time to come stern on to the wind. When operating long wires under very high tension such a turning movement is apt to have serious consequences, for the warp, leading across the stern, is liable to score deeply into the fair-lead cheeks, and even although the cheeks are recessed, may in a very short time cut its way through and jam on the axle of the horizontal roller.

[*Discovery Reports. Vol. XVIII, pp.* 121–222, *Plates III–VI, October* 1938.]

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CRINOIDEA

By

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CRINOIDEA

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(Plates III–VI; Text-figs. 1–24)

INTRODUCTION

The Discovery collection of crinoids is entirely of comatulids; no stalked form was taken. It was made between the years 1935 and 1937. There are three hundred and twenty-six specimens of which by far the greater number come from depths of between 100 and 600 m. Two hundred and sixty-nine are from the Antarctic region, the majority from the South American sector, a small number from the Ross Sea. Fifty-four are from the Burdwood Bank and the Patagonian shelf; they are of one species, *Isometra vivipara*, common to that region and the Antarctic.

The remaining three specimens, of *Comanthus novaezealandiae*, are from New Zealand.

The following is a complete list of the unstalked crinoids known from the shallower waters of Antarctic seas. The names of the two of which no specimens were secured are included in brackets. The number of specimens taken of each of the others is shown.

Family ANTEDONIDAE

Subfamily *HELIOMETRINAE*		
Promachocrinus kerguelensis Carpenter	163	specimens
Florometra mawsoni A. H. Clark	8	”
Florometra antarctica n.sp.	3	”
Anthometra adriani (Bell)	14	”
(*Solanometra antarctica* (Carpenter))		
Subfamily *ZENOMETRINAE*		
Eumorphometra aurora n.sp.	1	”
Eumorphometra fraseri n.sp.	1	”
Eumorphometra marri n.sp.	1	”
(*Eumorphometra concinna* A. H. Clark)		
Kempometra grisea n.g. and sp.	2	”
Subfamily *BATHYMETRINAE*		
Phrixometra longipinna var. *antarctica* n.var.	5	”
Phrixometra nutrix (Mortensen)	1	”
Phrixometra rayneri n.sp.	1	”
Subfamily *ISOMETRINAE*		
Isometra vivipara Mortensen	55	”
Isometra flavescens n.sp.	12	”
Isometra graminea n.sp.	8	”
Isometra hordea n.sp.	12	”

Family NOTOCRINIDAE

Notocrinus virilis Mortensen	26	”
Notocrinus mortenseni n.sp.	10	”

Nearly two-thirds of the specimens from the Antarctic are of *Promachocrinus kerguelensis*, the largest and most common of Antarctic crinoids. The bigger of the remaining species—those of the family Notocrinidae and the subfamilies Heliometrinae and Isometrinae—are represented by moderate or large numbers of specimens. Of the smaller species belonging to the subfamilies Zenometrinae and Bathymetrinae there are only one or two specimens, often imperfect, of each, despite the numerous dredgings made by the Discovery Committee's vessels. It seems probable that many more small species remain undiscovered in moderate depths in Antarctic seas.

I have included notes on the two species, *Solanometra antarctica* and *Eumorphometra concinna*, which are known to occur in the Antarctic but which are not represented in the Discovery collection; and on *Eumorphometra hirsuta* from Marion Island.

I have also partially redescribed from their types in the British Museum collection three non-Antarctic species, *Isometra lineata*, *I. angustipinna* and *Phrixometra longipinna*, to which certain of the Antarctic species are related.

How well many of the specimens are preserved may be seen by referring to the plates of this report. The larger were fixed by gently inducing them while still alive into tubes just wide enough to hold them, and then by adding strong spirit.

Myzostomum was found on *Promachocrinus kerguelensis*, the two species of *Florometra*, *Anthometra adriani*, *Isometra flavescens* and *Notocrinus mortenseni*.

In the lists of stations under each species the gear in which the specimens were caught is shown by means of symbols: OTL, DLH, etc. These symbols are explained in the introductions to the Station Lists in this series of reports (Vol. I, pp. 3–5, 1929; Vol. III, p. 4, 1930; Vol. IV, pp. 3–4, 1932) except for the following: DS, small dredge; DRR, a large dredge bag attached to the frame of a Russel bottom net.

I have examined the Antarctic comatulids, those collected by the National Antarctic ('Discovery') Expedition, 1901–4 and the British Antarctic ('Terra Nova') Expedition, 1910, in the British Museum collection. They were reported on by Bell in 1908 and 1917 respectively. He recorded *Antedon antarctica* (=*Solanometra antarctica*) which was not represented and did not recognize two species, *Florometra mawsoni* and *Notocrinus virilis*, which had not been described at that time but which were represented; he gave, too, only a few of the localities at which specimens were taken. I give at the end of this paper (p. 220) a complete record of the Antarctic comatulids taken by those expeditions.

The collection contains about fifty-eight pentacrinoid larvae.

About twenty of them are of *Isometra vivipara* and are attached to the upturned cirri of the females. The development of this species has been described by Mortensen (1920) and nothing is added here.

Clark (1921) has described a long series of pentacrinoid larvae of *Promachocrinus kerguelensis*. There are three in the present collection (p. 200).

The remaining larvae are of much greater interest, for they were not previously known. They are described in detail (pp. 202–219). There is a series of fifteen, the youngest a prebrachial stage, the oldest with three whorls of cirri, which I believe to be of the new species *Isometra hordea*. There are twenty, the youngest with the beginnings of arms, the oldest with only two whorls of cirri, which are of *Notocrinus virilis*. The fully-formed larva of this species has been described by Mortensen (1920).

NEW FORMS

The proportion of new forms is very large: I have described ten new species and one new variety. One of the new species, *Notocrinus mortenseni*, belongs to the peculiar genus for which Mortensen found it necessary to establish a new family, the Notocrinidae (Mortensen, 1918); only the type species, *N. virilis*, also from the Antarctic and abundantly represented in the present collection, was previously known. Clark (1937) has recently described a new species of *Florometra*, *F. mawsoni*, from the Antarctic. It was taken by the Discovery vessels and they also found three specimens of a new species, *F. antarctica*.

There are three new species of *Isometra*. Two resemble *I. vivipara* but differ too strongly from it to be described as identical; the third, *I. hordea*, is undoubtedly a distinct form.

The other five new species are of smaller forms, each represented by a few specimens only. For one of them, unique among Antarctic comatulids in that it lacks oral pinnules, I have had to create a new genus, *Kempometra*. Three appear to be new species of *Eumorphometra* of which two species, one from the Antarctic and one from Marion Island, were previously known. I have described a new species and a new variety of *Phrixometra*, a genus previously known from one species taken off the River Plate.

CARE OF THE BROOD

The main interest of the collection is that it contains so many species which care for the brood; which are, in other words, viviparous.

The vast majority of comatulids shed their eggs directly into the sea. Only three viviparous species were previously known. In this paper I add to that number five new species and one new variety from the Antarctic, and two described species, one from the Antarctic and one from off the River Plate, which their authors had not recognized as viviparous. Thus there are now eleven known viviparous comatulids.

The three previously known species were *Isometra vivipara* from the Patagonian shelf, the Burdwood Bank and the Antarctic; *Phrixometra nutrix* from the Burdwood Bank; *Notocrinus virilis* from the Antarctic. All three were taken by the Swedish South-Polar Expedition and they and their viviparous habits were described by Mortensen (1918, 1920).[1]

[1] The care of the brood in *Isometra vivipara* had been described long before by K. A. Andersson (1904), who did not however recognize the species as new but regarded it as *Antedon hirsuta* (=*Eumorphometra hirsuta*).

The Discovery collection contains many specimens of *Isometra vivipara* and *Notocrinus virilis*; there is one male of *Phrixometra nutrix* from the Bransfield Strait in the Antarctic.

The following table includes these three species and the seven species and one variety which are shown in this paper to be viviparous; it is a complete list of the known viviparous crinoids.[1] The localities from which each is recorded are shown.

	Antarctic	Outside the Antarctic		
		Burdwood Bank	Patagonian Shelf	Off River Plate
Eumorphometra concinna A. H. Clark	+	–	–	–
Kempometra grisea n.sp.	+	–	–	–
Phrixometra longipinna (Carpenter)	–	–	–	+
P. longipinna var. *antarctica* n.var.	+	–	–	–
P. nutrix (Mortensen)	+	+	–	–
Isometra vivipara Mortensen	+	+	+	+
I. flavescens n.sp.	+	–	–	–
I. graminea n.sp.	+	–	–	–
I. hordea n.sp.	+	–	–	–
Notocrinus virilis Mortensen	+	–	–	–
N. mortenseni n.sp.	+	–	–	–

The table includes two species, *Eumorphometra concinna* and *Phrixometra longipinna*, which were not taken by the Discovery vessels. I owe my knowledge that the former is viviparous and the opportunity of describing its brood-pouches to Mr A. H. Clark: when he heard from me how many viviparous forms I was finding he re-examined *Eumorphometra concinna*, saw that the female had brood-pouches and immediately sent me some. Carpenter had described "much swollen ovarian" sacs in *Phrixometra longipinna*; I found them to be brood-pouches.

The table shows that of the eleven viviparous forms eight are known only from the Antarctic. One is known from the Antarctic and the Burdwood Bank, another from the Antarctic, the Burdwood Bank and the east coast of South America as far north as the River Plate. One is known from off the River Plate only.

If the table be compared with the list on p. 123 it will be seen that of the nineteen comatulids known from the Antarctic ten, over 50 per cent, are viviparous. More than 600 species of unstalked crinoids are known from other seas and only five of them, two of which also occur in the Antarctic (*Isometra vivipara* and *Phrixometra nutrix*), are viviparous; the other two are *P. longipinna* and the two viviparous forms from southern Australia.

The percentage of viviparous forms from the Antarctic may be considerably higher. All the Antarctic species of the Notocrinidae and the Isometrinae, but only four of the eight species of the Zenometrinae and Bathymetrinae, are viviparous. But the remaining four species of the Zenometrinae and Bathymetrinae are known from single specimens and each is a male. It may be that when the females are found some or all of these species will be discovered to be viviparous. The five large species of the subfamily Heliometrinae are not viviparous.

---

[1] Since this was written two species from southern Australia have been described as viviparous (H. L. Clark, 1938, *Echinoderms from Australia*, Mem. Mus. Comp. Zoöl., LV, pp. 40–1).

Dr Mortensen has shown in a recent Discovery Report (1937) that there is in Antarctic ophiuroids a similar very high percentage of viviparous forms. The Antarctic ophiuroid fauna is much richer in species than the crinoid fauna. About 50 per cent of them are viviparous. The highest percentage elsewhere is 15, in New Zealand.

When Mortensen (1918, p. 2) made known the first three viviparous forms he remarked that it added to their interest that each had a separate way of caring for the brood; he was indeed fortunate, for he had three most interesting species before him. The methods of the eleven viviparous forms now known are compared below.

In only one group, the species of *Isometra*, does the viviparous habit appear to have led to a modification of the hard parts. The segments of the genital pinnules of the females are strongly expanded to arch over and protect the ovary and brood-pouch. There is a much smaller expansion of the segments carrying the testes in the male—so much smaller that whereas in almost all comatulids males and females are indistinguishable to the naked eye, in the species of *Isometra* they may be recognized at a glance.

In all the viviparous species there is in the female a brood-pouch beside each ovary.

In *Notocrinus virilis* and *N. mortenseni* the gonads have a unique position. They do not lie, as in all other crinoids, along the pinnules, but in the axils between the pinnules and the arms, largely on the arms. The brood-pouches of the females are distal to the ovaries. The two species form an interesting contrast in the extent to which they protect the brood. A brood-pouch of a big *N. mortenseni* may contain as many as ninety-two embryos in all stages of development and varying in size from 0·25 to 0·48 mm. The largest have five broad bands of cilia; they presumably go through a free-swimming stage before metamorphosing into pentacrinoids. The brood-pouches of *N. virilis* each contain only one to three, usually two, embryos, all at the same stage of development. They are up to 2 mm. in length, that is, four times as long as those of *N. mortenseni*, and have no trace of ciliated bands. It must be supposed that they drop out of the brood-pouches to the sea floor and change into pentacrinoids there. A series of pentacrinoids is described on pp. 210–219.

In the other viviparous crinoids the brood-pouches lie alongside, or beyond, the ovaries on the pinnules. They lie alongside the ovaries and always on their distal sides, i.e. on the side of the pinnule nearest to the arm from which it springs, in *Eumorphometra concinna*, *Phrixometra longipinna*, *P. longipinna* var. *antarctica* and the four species of *Isometra*.

In these species each brood-pouch contains a fair number of small embryos which possess ciliated bands. (I can see no ciliated bands in those of *Phrixometra longipinna*, but I think that is because they are too young.) It is probable that in these species, as in *Notocrinus mortenseni*, the embryos pass some time in a free-swimming stage before metamorphosing into pentacrinoids. Mortensen has described how short the free-swimming stage is in *Isometra vivipara*: the embryos travel no farther than the upturned cirri of their mothers before settling down and turning into pentacrinoids. This has not been observed in any of the other species. In *Phrixometra longipinna* and one of the females of the var. *antarctica* all the embryos in the brood-pouches are at the same stage of development. In the other species and the other female of *P. longipinna* var. *antarctica* they are, as in *Notocrinus mortenseni*, at various stages of development.

In the single known female of *Phrixometra nutrix* the brood-pouches lie on the oral side of some pinnules, on the aboral side of others. In *Kempometra grisea* the brood-pouches are on the aboral side of the pinnules, but they lie for the most part beyond, not alongside, the ovaries. In these two species the care of the brood is carried even farther than in *Notocrinus virilis*. *Phrixometra nutrix* protects the young throughout their larval existence so that they leave the parent as young comatulids. It seems probable that *Kempometra grisea* does the same.

The larvae of *Phrixometra nutrix* change into pentacrinoids in the brood-pouch. The stalk is attached to the wall of the brood-chamber or to the pinnule segment on its floor; the head projects through a slit in the wall. In the single known female the brood-pouches hold one or two pentacrinoids each; where there are two they are at the same or at different stages of development. No brood-pouch contains developing embryos (Mortensen, 1918).

In the two females of *Kempometra grisea* in this collection I found one large embryo in one pouch, two in another, a pentacrinoid larva in a third. The pentacrinoid is still completely enclosed in the pouch, which is not ruptured. No pentacrinoid emerges from any brood-pouch as in *Phrixometra nutrix*, nor is one attached to any part of the body. The ovary contains few, four to nine, very large eggs; they are up to 0·6 mm. long.

It is interesting to see that in those species in which the care of the young is carried the farthest—*Notocrinus virilis*, *Phrixometra nutrix* and *Kempometra grisea*—the number of young produced is the smallest.

DISTRIBUTION AND RELATIONSHIPS

The table below shows the localities from which the Antarctic comatulids are known. The localities within the Antarctic are divided into "continental coasts and adjacent islands" and "outlying islands". In the former category the term "and adjacent islands" has an application only to the Weddell Sea sector in which the South Shetland Islands, separated from the shores of Graham Land by neither great distance nor deep water, are grouped with it. No crinoid has yet been named from the South Orkney Islands though the 'Scotia' took feather-stars in Scotia Bay (Wilton, Pirie and Brown, 1908, p. 21). The South Sandwich Islands, South Georgia and the Shag Rocks are outlying islands in the Weddell Sea, or South American, sector. Heard Island and Kerguelen are in the Indian Ocean sector. Kerguelen lies on the extreme northern edge of the Antarctic area: the Antarctic convergence, the boundary between the surface waters of the Antarctic and sub-Antarctic zones, passes through it (Deacon, 1937, p. 23 and fig. 5). Kerguelen and the adjacent islands may, however, be regarded as a sub-Antarctic district (see pp. 130–131).

	Antarctic localities								Non-Antarctic localities	
	Continental coasts and adjacent islands			Outlying islands					South America	
	Weddell Sea sector	Indian Ocean sector	Ross Sea sector	South Sandwich Islands	South Georgia	Shag Rocks	Heard Island	Kerguelen	Burd-wood Bank	Patagonian Shelf
P. kerguelensis	+	+	+	+	+	.	+	+	.	.
F. mawsoni	+	+	+	.	.	.	.	.	.	.
F. antarctica	+	.	.	.	.	.	.	.	.	.
A. adriani	+	+	+	.	.	.	.	.	.	.
S. antarctica	.	+	.	.	.	.	+	.	.	.
E. aurora	.	.	.	.	.	+	.	.	.	.
E. fraseri	+	.	.	.	.	.	.	.	.	.
E. marri	+	.	.	.	.	.	.	.	.	.
E. concinna	.	+	.	.	.	.	.	.	.	.
K. grisea	+	.	.	.	.	.	.	.	.	.
P. longipinna var. *antarctica*	+	.	.	.	+	.	.	.	.	.
P. nutrix	+	.	.	.	.	.	.	.	+	.
P. rayneri	.	.	.	.	.	+	.	.	.	.
I. vivipara	+	.	.	.	.	.	.	.	+	+
I. flavescens	.	.	.	.	.	+	.	.	.	.
I. graminea	+	.	+	.	.	.	.	.	.	.
I. hordea	+	.	.	.	.	.	.	.	.	.
N. virilis	+	+	+	.	.	.	.	.	.	.
N. mortenseni	+	.	.	.	.	.	.	.	.	.

The table shows that seventeen of the nineteen Antarctic comatulids occur in the Weddell Sea sector (in the wider sense, i.e. including outlying islands); six in the Indian Ocean sector, including Kerguelen and Heard Island; five in the Ross Sea sector. Four species, *Promachocrinus kerguelensis*, *Florometra mawsoni*, *Anthometra adriani* and *Notocrinus virilis*, occur in all three sectors and may therefore be presumed to be circumpolar. They are all large species and therefore the most likely to be taken by collecting expeditions. This and the fact that more collecting, and more careful collecting, has been done in the Weddell Sea sector than in any other makes me think that many of the species now known from there alone may later be found elsewhere around the continent; in other words I think it premature to discuss the distribution of the species within the Antarctic. Of the species that are known to be circumpolar *Promachocrinus kerguelensis* has been found at all the Antarctic localities where collecting has been done except the Shag Rocks; the other three are, so far as is known, confined to the coasts of the continent and the adjacent islands.

The most interesting feature of the table is that it shows that two Antarctic species do occur outside the Antarctic and that they occur towards or along the east coast of South America: *Phrixometra nutrix* on the Burdwood Bank, *Isometra vivipara* on the Burdwood Bank and on the Patagonian shelf as far north as the River Plate.

There are, I think, other reasons for believing that the shallower water crinoid fauna of the Antarctic is related to that of the extreme south of South America. The *Phrixometra*, of which the Discovery vessels took five specimens, one at South Georgia and four in the Bransfield Strait, is so like Carpenter's *Phrixometra longipinna* from off the River Plate that I have described it as a variety. The only other species of the genus are *P. nutrix*, and *P. rayneri* from the Shag Rocks.

There are four species of *Isometra* in the Antarctic, one of which also occurs on the east coast of South America. Two other species are known, each described from a single Challenger specimen taken off the River Plate.

These facts point to a relationship between the shallow-water crinoid faunas of the Antarctic and of the east coast of the extreme south of South America. There appears to be a relationship with the west coast of South America too.

Of the four genera of the Heliometrinae represented in the Antarctic three, *Promachocrinus*, *Anthometra* and *Solanometra*, are monotypic and the species are confined to the Antarctic. The fifth, *Florometra*, of which there are two species in the Antarctic, has ten other species ranging northwards from Cape Horn along the west coasts of South and North America to the Behring Sea, westwards along the Aleutian Islands, and southwards to the Pacific coast of Japan.

It appears from these facts that the littoral crinoid fauna of the Antarctic is related to that of the south of South America. Workers on the other four classes of echinoderms have arrived at the same conclusion for those classes. Mortensen (1910, p. 100) wrote of echinoids: "The South American (Patagonian-Chilean) littoral region must be regarded as the centre of the whole Antarctic—sub-Antarctic region; a very great proportion of the echinoids occurring in the Patagonian region are known from this region alone, while others are also known from the Antarctic region." Koehler (1912, p. 242), after comparing the littoral asteroid, ophiuroid and echinoid faunas of the Antarctic, the Magellan region of South America, the Kerguelen district, New Zealand and the Cape concludes: "Il ressort clairement de cette discussion que la faune antarctique des Astéries, Ophiuries et Échinides,—du moins en ce qui concerne les espèces littorales,—a son point de départ dans la faune subantarctique des côtes de la pointe de l'Amérique du Sud. Les comparaisons que nous avons faites, la composition et les rapports des faunes établissent ce fait d'une manière indiscutable." Ekman (1925, p. 187) writing of holothurians concludes: "Hier möchte ich nur die Meinung aussprechen, dass die von anderen Forschern hervorgehobene, verhältnismässig nahe Verwandtschaft der antarktischen Litoralfauna mit derjenigen des Magellangebietes auch betreffs der Holothurien Gültigkeit hat, und dass allem Anschein nach beide aus einem gemeinsamen Entwicklungszentrum herstammen."

There is only one other species of *Eumorphometra* than those listed above; it is *E. hirsuta* (Carpenter) from Marion Island. Marion Island belongs to the Kerguelen group of islands comprising Kerguelen itself, Heard Island, the Crozets and Marion Island. It possesses in more groups of animals than one a characteristic littoral fauna, partly related to, or having species in common with, those of two other areas, the

Antarctic and the Magellan region of South America. So far as three classes of echinoderms—asteroids, ophiuroids and echinoids—are concerned the fauna of the Kerguelen group is much more nearly related to the fauna of the Magellan region than to that of the Antarctic (Mortensen, 1910, p. 100; Koehler, 1912, pp. 221–7). But Regan (1914, p. 36), having studied the fish faunas of the three regions, describes the Kerguelen group as an Antarctic district; and Norman in two papers on more recent collections of fishes confirms his views (1937, 1938). He says (1938, p. 100): "it is clear that, although the coastal fish fauna of the Kerguelen district shows certain features of resemblance to that of the Patagonian region and the Antipodes, its affinities are mainly with that of Antarctica."

Since no crinoid is known to occur both in the Kerguelen and Magellan districts, whereas two (*Promachocrinus kerguelensis* and *Solanometra antarctica*) are known both from Kerguelen and Heard Islands and the Antarctic, I have treated those islands, with the above reservations, as outliers of the Antarctic.

No other species of *Notocrinus* than *virilis* and *mortenseni* are known.

ACKNOWLEDGEMENTS

It is a great pleasure to acknowledge in the first place the constant and generous help I have received from Mr A. H. Clark. When he knew that I was finding many viviparous species he re-examined his co-types of *Eumorphometra concinna*, found that it too was viviparous, and sent me brood-pouches so that I might describe them. He has kindly compared my single specimen of *E. aurora* with *E. concinna* and has found that they are not, as I thought they might be, identical. He examined for me a specimen of *Kempometra grisea*, suggested the diagnosis of the genus which I have used, and helped me to decide upon the position of the genus.

Dr Mortensen has helped me by comparing a specimen of my *Isometra graminea* with one of his specimens of *I. vivipara*, taken by the Swedish Antarctic Expedition, from the Graham Land region; and Professor Sixten Bock of Stockholm kindly sent me, for examination and comparison, all the remaining specimens of *I. vivipara* taken by the Swedish Expedition. I take this opportunity of thanking them both.

The drawings for the text-figures were made by Miss E. C. Humphreys.

KEY TO THE COMATULIDS KNOWN TO OCCUR IN DEPTHS OF 0–1000 METRES IN ANTARCTIC SEAS

A Oral pinnules long and whip-like; P_1 of 30–60 or more segments; P_2 usually as long; large species.
  B 6–11 rays and 12–23 arms—usually 10 rays and 20 arms *Promachocrinus kerguelensis.*
  BB 5 rays and 10 arms.
    C Ossicles of the division series and the brachials with a conspicuous and usually high narrow median keel; cirri of large specimens of 60–80 segments; P_2 much shorter than P_1 ... ... *Anthometra adriani.*

CC Division series and brachials not as above; cirri of not more, usually much less, than 40 segments; P_2 about as long as P_1.

D P_1 of 28–40 segments; cirri of not more than 31 segments; lower brachials with an abruptly elevated spinous patch in the distal portion of the dorsal surface or with the distal edge everted at right angles and strongly produced ... ... *Florometra mawsoni.*

DD P_1 of more than 40 segments; lower brachials smooth or, exceptionally, elevated into small and low spinous patches.

E P_1 of about 60 segments; cirri of 25–40 segments; lower brachials smooth; brachials beyond third syzygy all short, much broader than long ... ... *Solanometra antarctica.*

EE P_1 of 44–50 segments; cirri of 23–32 segments; lower brachials may have small spinous patches; brachials beyond third syzygy not much broader than long ... ... *Florometra antarctica.*

AA P_1 of less than 20 segments, usually short.

B Third and some of succeeding segments of genital pinnules strongly expanded to cover the gonads; oral pinnules short with their basal segments attached to the disk or to the arm by webs of tissue.

C P_2 shorter than P_1.

D Ventral surface of disk plated; P_3 is first genital pinnule *Isometra flavescens.*

DD Ventral surface of disk naked; P_4–P_6, usually P_5, first genital pinnule *Isometra vivipara.*

CC P_2 as long as or longer than P_1.

D Longest cirri of up to 70 segments; large robust species *Isometra hordea.*

DD Cirri of 28–43 segments; fragile species of medium size *Isometra graminea.*

BB No segments of genital pinnules strongly expanded.

C Gonads not on pinnules but in axils between pinnules and arms; perisome plated; oral pinnules short with their basal segments attached to the disk or to the arms by webs of tissue.

D Cirri long, of 36–76 short segments of nearly uniform length *Notocrinus virilis.*

DD Cirri shorter, of 21–32 segments of which some of the proximal are longer than the remainder ... ... *Notocrinus mortenseni.*

CC Gonads in normal position on genital pinnules; perisome not plated; oral pinnules (where present) entirely free.

D P_1 and P_a absent; P_3 a genital pinnule ... ... *Kempometra grisea.*

DD Oral pinnules present.

E Cirri of less than 20 (12–19) segments.

F First genital pinnule (P_2 or P_3) not much more than half as long as P_1 ... ... *Phrixometra longipinna* var. *antarctica.*

FF First genital pinnule (P_2 or P_3) about as long as P_1.

G Cirri about XLV ... ... *Phrixometra nutrix.*

GG Cirri about XXX ... ... *Phrixometra rayneri.*

EE Cirri of more than 20 segments (of up to 40 segments).

F Cirri of 30–40 segments ... ... *Eumorphometra fraseri.*

FF Cirri of less than 30 segments.

G Cirri in 2 or 3 closely placed alternating rows; P_1 longer and more massive than P_2; in the lower genital pinnules the segments carrying the gonad are slightly expanded *Eumorphometra marri.*

GG Cirri in 10 slightly irregular columns; P_1 not more massive than P_2; segments of genital pinnules not expanded.

H Elements of division series and brachials with central portion abruptly elevated and prominently spinous; axillaries shorter (broader than long) *Eumorphometra concinna.*

HH Elements of division series and brachials not as above; axillaries longer (longer than broad) *Eumorphometra aurora.*

SYSTEMATIC ACCOUNT

Family ANTEDONIDAE

Subfamily *HELIOMETRINAE*

Genus **Promachocrinus** Carpenter

Promachocrinus kerguelensis Carpenter (Plate III, fig. 1)

Promachocrinus kerguelensis Carpenter, 1888, p. 350, pl. i, figs. 1 *a–d*, pl. lxx; Clark, 1915 *a*, pp. 128–34, pls. iii–v, and list of earlier references with synonymy; Clark, 1915 *b*, many references, fig. 505; Bell, 1917, p. 2; Mortensen, 1918, pp. 18–20, fig. 16; Clark, 1921, numerous references including pp. 530–57, figs. 881–937 (on pentacrinoid young), pl. iv, figs. 1001–2, fig. 807; Mortensen, 1925 *b*, p. 2; Gislén, 1928, p. 11; Grieg, 1929 *a*, p. 3; 1929 *b*, p. 3; Clark, 1929, p. 662; Bernasconi, 1932 *a*, pp. 29–35, figs. 1–3, pl. i; 1932 *b*, pp. 86–7, fig.; John, 1937, p. 9; Clark, 1937, pp. 8–9.

Promachocrinus vanhöffenianus Minckert, 1905, pp. 496–501, figs. 1 and 2.

Promachocrinus joubini Vaney, 1910, pp. 158–62, figs. 1 and 2.

The stations at which it was taken are divided into five groups, according to locality, below.

South Georgia

St. MS 14. 17. ii. 25. East Cumberland Bay. 190–110 m. Gear DS. Two small specimens.

St. MS 71. 9. iii. 26. East Cumberland Bay. 110–60 m. Gear BTS. Twenty-eight specimens, mostly large.

St. MS 74. 17. iii. 26. East Cumberland Bay. 22–40 m. Gear NCS–T. Fragments.

St. 27. 15. iii. 26. West Cumberland Bay. 110 m. Gear DL. Bottom: mud and rock. One specimen; one pentacrinoid larva.

St. 39. 25. iii. 26. East Cumberland Bay. 179–235 m. Gear OTL. Bottom: grey mud. One specimen.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay. 120–204 m. Gear OTL. Bottom: mud. Eight specimens.

St. 123. 15. xii. 26. Off mouth of Cumberland Bay. 230–250 m. Gear OTL. Bottom: grey mud. One specimen.

St. 144. 5. i. 27. Off mouth of Stromness Harbour. 155–178 m. Gear OTL. Bottom: green mud and sand. Six specimens.

St. 148. 9. i. 27. Off Cape Saunders. 132–148 m. Gear OTL. Bottom: grey mud and stones. Four specimens.

St. 149. 10. i. 27. Mouth of East Cumberland Bay. 200–234 m. Gear OTL. Bottom: mud. Five specimens.

St. 152. 17. i. 27. 53° 51′ 30″ S, 36° 18′ 30″ W. 245 m. Gear DLH. Bottom: rock. Two specimens.

St. 156. 20. i. 27. 53° 51′ S, 36° 21′ 30″ W. 200–236 m. Gear DLH. Bottom: rock. Eight specimens.

St. 345. 8. ii. 30. 55° 20′ S, 34° 47′ 30″ W. 180 m. Gear N 70 V. Bottom: small stones and shells. One specimen.

South Sandwich Islands

St. 363. 26. ii. 30. 2·5 miles S, 80° E of south-east point of Zavodovski Island. 329–278 m. Gear DLH. Bottom: scoria. Three specimens.

St. 366. 6. iii. 30. 4 cables south of Cook Island. 77–152 m. Gear OTL. Bottom: black sand. Six specimens; 1 pentacrinoid larva.

St. 371. 14. iii. 30. 1 mile east of Montagu Island. 99–161 m. Gear OTL. Five specimens.

Bransfield Strait region

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ W. 342 m. Gear DLH. Bottom: rock. Six specimens.

St. 172. 26. ii. 27. Off Deception Island. 62° 59′ S, 60° 28′ W. 525 m. Gear DLH. Bottom: rock. Two specimens.

St. 175. 2. iii. 27. Bransfield Strait. 63° 17′ 20″ S, 59° 48′ 15″ W. 200 m. Gear DLH. Bottom: mud, stones and gravel. Three specimens.

St. 177. 5. iii. 27. 27 miles south-west of Deception Island. 63° 17′ 30″ S, 61° 17′ W. 1080 m. Gear DLH. Bottom: mud, coarse sand and stones. Eight specimens; one pentacrinoid larva.

St. 1948. 4. i. 37. 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. One specimen.

St. 1952. 11. i. 37. Between Penguin Island and Lion's Rump, South Shetlands. 367–383 m. Gear DRR. Bottom: soft mud. Forty-three specimens.

St. 1955. 29. i. 37. 61° 35·1′ S, 57° 23·3′ W. 440–410 m. Gear DRR. Two specimens.

St. 1957. 3. ii. 37. 7 miles east of Cape Bowles, Clarence Island, South Shetlands. 830 m. Gear DRR. Bottom: rough, stony. One specimen. 785–767 m. Gear DRR. Bottom: stones. One specimen.

West coast of Graham Land

St. 180. 11. iii. 27. 1·7 miles west of north point of Gand Island, Schollaert Channel, Palmer Archipelago. 160–330 m. Gear OTL. Bottom: mud and stones. Five specimens.

St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago. 64° 20′ S, 63° 01′ W. 160–335 m. Gear OTL. Bottom: mud. Three specimens.

St. 182. 14. iii. 27. Schollaert Channel, Palmer Archipelago. 64° 21′ S, 62° 58′ W. 278–500 m. Gear OTL. Bottom: mud. Six specimens.

St. 599. 17. i. 31. Adelaide Island. 67° 08′ S, 69° 06′ 30″ W. 203 m. Gear DLH. One specimen.

The Ross Sea

St. 1644. 16. i. 36. Bay of Whales. 78° 24·8′ S, 164° 10·3′ W. 626 m. Gear BNR. Bottom: rocks and mud. One specimen.

St. 1652. 23. i. 36. Ross Sea. 75° 56·2′ S, 178° 35·5′ W. 567 m. Gear DRR. Nineteen specimens.

St. 1658. 26. i. 36. Off Franklin Island, Ross Sea. 76° 09·6′ S, 168° 40′ E. 520 m. Gear DRR. Four specimens, one very young.

Historical. Carpenter (1888, p. 348) included in his definition of the genus *Promachocrinus* the words "ambulacra...not provided with any definite skeleton".

Minckert (1905, p. 496, figs. 1, 2), on the basis of two fully grown specimens from the collection of the Deutsche Südpolar-Expedition, described the new species *P. van-*

höffenianus differing from *P. kerguelensis* in having: (i) longer cirrus segments, (ii) long and slender axillaries and second brachials, (iii) no lateral notch between the radial and the costal, and (iv) well-developed side-plates along the pinnule ambulacra.

Vaney (1910, pp. 158–62, figs. 1, 2) described the new species *P. joubini*, from one specimen from the west of Graham Land. It is described as being distinguished from *P. kerguelensis* by having clusters of spines on the lower brachials, by the position of its syzygies, and by the possession of a naked dorsal pole. Like *P. kerguelensis* it has rhombic axillaries and lacks an ambulacral skeleton; its cirri are tolerably like those of *P. vanhöffenianus*. Vaney considered it to be nearer the former than the latter.

Clark (1915) regards both Minckert's and Vaney's species as invalid, believing the specimens upon which they were based to have been immature *P. kerguelensis*. Mortensen (1918, p. 19) is not satisfied that Clark is correct, more particularly in regarding *P. vanhöffenianus* as identical with *P. kerguelensis*; nor is he convinced that the presence of an ambulacral skeleton is a sign of immaturity, a doubt shared by Grieg who is otherwise inclined to accept Clark's opinion (Grieg, 1929 *a*, p. 4; 1929 *b*, p. 4).

My examination of the present collection of 163 specimens from low and high latitudes in the Falkland sector of the Antarctic zone, and of thirty-eight specimens from the Ross Sea, and of one or two taken by the 'Challenger' near Kerguelen and Heard Island, has convinced me that there is only one, very variable, species.

DESCRIPTION. In the great majority of specimens there are 10 rays and 20 arms but individuals with 12, 16, 17, 18, 19, 22 and 23[1] arms occur. The arms of large specimens are commonly 180–200, and may be up to 250, mm. long.

The centrodorsal is usually a large high rounded cone, but it is variable. It may be more sharply conical; in smaller specimens it is often a moderately low cone. It is closely covered with cirri which may, exceptionally, number 200 or more. The cirrus sockets are arranged in slightly irregular alternating rows, so that those of alternate rows make slightly irregular columns. The dorsal pole is usually of medium size, smooth and rounded. In large specimens it is sometimes sunken and rough. It may, in either large or small specimens, be a sharply triangular or a rough truncated pillar-like projection. It may be very small or absent: though this is most often so in small specimens it may be so in large.

Cirri: up to CC or more. There is always a sharp contrast between the apical cirri and those of the more ventral part of the centrodorsal: the latter are long, of up to 47 or, exceptionally, 65 segments; the former very much shorter and of fewer segments. The contrast is greatest in large specimens; the longest peripheral cirri may be three or more times as long as the shortest apical cirri. They may be up to 130 mm. long.

The segments of the cirri of different specimens vary greatly in length. I have seen none in which those of one cirrus are so nearly equal to one another as in Carpenter's figure. The range of variation is illustrated by the extremes shown in Fig. 1; a_1 and a_2 are a long and a short cirrus of a specimen with cirri of short segments, and a_3 and a_4 are

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[1] Mortensen, 1918, p. 19.

those of a specimen with cirri of long segments. The cirrus a_1 is of 52 segments and is nearly 75 mm. long. The first three segments are short, the fourth is longer than broad; the fifth and sixth are nearly twice as long as broad, the seventh to about the twentieth or twenty-fifth twice as long as broad. The remainder gradually decrease in length until the most distal are as broad as long. In the segments following the first ten or so the distal edge projects slightly on the dorsal side; the projection is most marked, but not strong, in the distal segments. All but the basal segments are compressed from side to side, the distal most strongly.

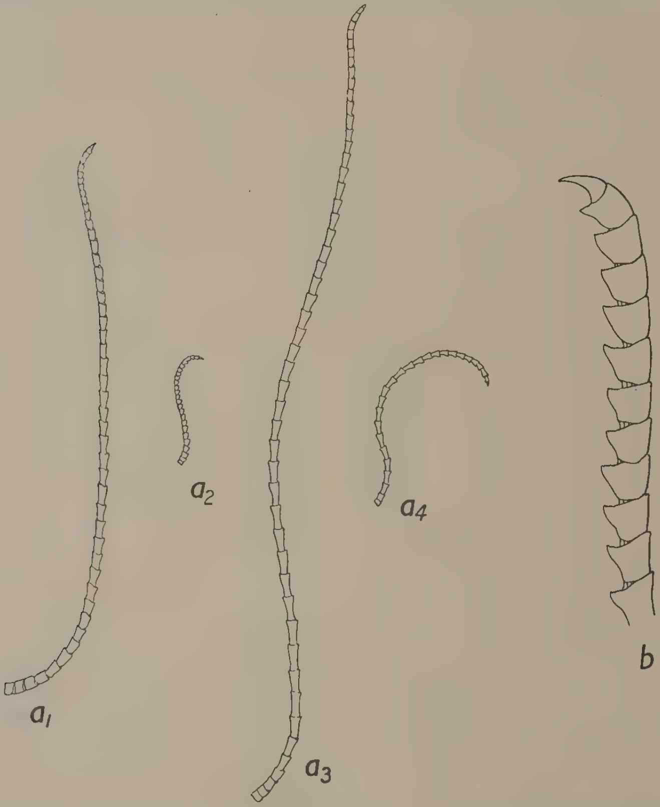

Fig. 1. *Promachocrinus kerguelensis.* a_{1-2}, long and short cirri of a specimen with cirri of short segments, ×1·25. a_{3-4}, the same of a specimen with cirri of long segments, ×1·25. *b*, distal segments of a short cirrus, ×9.

The small apical cirrus of the same specimen, a_2, is of 24 segments and 15 mm. long. The basal segments, the first two or three, are broader than long; the proximal are longer than broad but not nearly so much so as in the long cirri. The distal segments are as broad as long and have the dorsal projection more strongly developed and more keel-like than do those of the larger cirri.

The more elongated cirrus, from another specimen, shown in Fig. 1 a_3, is of 51 segments and nearly 100 mm. long. The first two segments are broader than long, the third about as long as broad. The fourth is longer than broad; the fifth is nearly, the sixth more than, twice as long as broad. The seventh and eighth are about three times as long as broad. The ninth to about the fourteenth are the longest: more than three times as long as broad.[1] Beyond the fourteenth the segments gradually decrease in length but the most distal are nearly twice as long as broad. They have a less well-marked projection on the dorsal side than those of cirrus a_1. The whole cirrus is less robust; it is slightly compressed from side to side.

The shortest apical cirrus from the same specimen, a_4, is of 26 segments and about 30 mm. long. The first two segments are broader than long, the third nearly twice as long as broad. The fourth is $2\frac{1}{2}$ times as long as broad; the fifth and sixth are the longest: nearly three times as long as broad. The segments beyond gradually decrease in length to the end, the most distal being, however, nearly twice as long as broad. The segments of this cirrus, particularly the outer and especially on the dorsal side, overlap one another much more strongly than do those of the long cirrus from the same specimen.

The terminal claw is mostly curved, claw-like and hyaline and there is usually a small opposing spine or the trace of one; but some of the longer cirri of younger specimens, or even all the cirri of older specimens, may entirely lack the opposing spine, and at the same time the terminal claw may be straight, not claw-like, and it may not be hyaline. The opposing spine may, however, be strong, especially on small apical cirri (Fig. 1 *b*).

The radials, primibrachs and first and second brachials are very variable in shape (Fig. 2 *a*). They differ, though not constantly nor in the same way, in different specimens, with age. Since very few preserved specimens have complete arms it is not possible to use arm length as a rough criterion of age. I have used instead the number of segments in the longer peripheral cirri: in Fig. 2 *a* the number beside each separate drawing is that of the segments in the longest peripheral cirrus of that specimen. In very young specimens in which the interradial rays are still smaller than the others the alternate radials are of a different shape and size (a_1): those of the radial ray are comparatively wide, wider at the base than distally; the interradial radials are longer, narrower plates, wider distally than at the base. The distinction in size between the alternate rays does not appear to last long. In older, but still small immature specimens, the radials and succeeding ossicles are of the shapes shown in a_2 or of similar shapes. The radial is long; the costals are not in opposition laterally. The axillary is shield-shaped, longer than broad; it makes no shoulder-like projection by its incision of the costal. In older specimens the radials are always shorter, and in large specimens they may be very short (Fig. 2, a_3 and a_4). In some, but by no means all, old specimens in which the radials are very short the costals are in partial lateral opposition, as if they had been brought down against one another by the reduction of the radials (a_3). The axillary may be of any of the shapes shown in Fig. 2 a_1–a_4, or of a shape intermediate between them. It may be elongated and longer than broad, or it may be broader than long; the second brachials vary with it. In the biggest specimens its incision of the costal and the incision of the first brachial by the second make shoulder-like projections which may

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[1] I have seen these segments four times as long as broad in the cirri of another specimen.

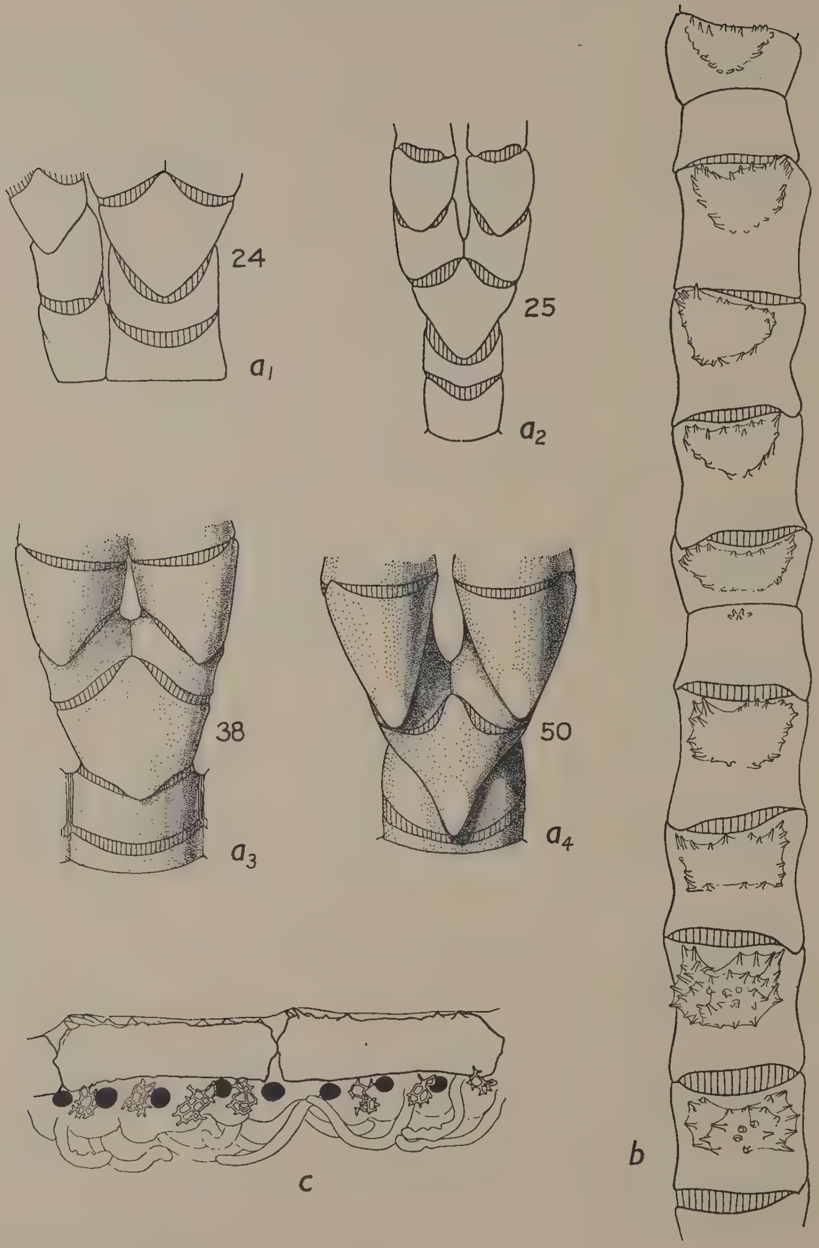

Fig. 2. *Promachocrinus kerguelensis. a*, radials, costals, axillaries and lower brachials of specimens of different ages; the numbers beside the figures are those of the segments in the longest peripheral cirrus of each specimen; 1 and 2, ×13; 3 and 4, ×7. *b*, fourth to fifteenth brachials showing the dorsal surfaces raised into spinous patches, ×11. *c*, largest side-plates found in the distal pinnules of specimens from the South Sandwich Islands, ×47.

be faint or exceedingly strong: they are faint when the axillary and second brachial are broad and short, strong when they are elongated (compare a_3 and a_4). The partial lateral apposition of the costals referred to above appears to come about only in those old specimens in which the axillaries are comparatively wide and form a faint, or no, shoulder with the costals.

The first syzygy is between the third and fourth brachials; the second and third are usually between the ninth and tenth and fourteenth and fifteenth respectively, though irregularities occur. The syzygial pairs beyond the third are separated by one to five, usually two or three, brachials.

The brachials between the first and third or fourth syzygies are rectangular or quadrate, usually broader than long, but sometimes as long as broad or even slightly longer than broad. Beyond the third or the fourth syzygy the brachials are triangular or wedge-shaped, broader than long or as long as broad. The distal brachials are rectangular, as long as or longer than broad. The brachials of young specimens are proportionately longer than those of older specimens.

The lower brachials may be smooth or spiny; the distal edges of the outer brachials are nearly always slightly raised and produced into spines. The brachials between the first and second syzygies may have more than the distal halves of their dorsal surfaces raised into rectangular patches of strong spines standing out at right angles to the surface, conspicuous in profile (Fig. 2 *b*); the patches become smaller in area and more triangular in shape between the second and third syzygies; beyond the third syzygy they become reduced to a row of strong forwardly directed spines along the distal edge of the segment, and they persist as such to the end of the arm. The spine patches of the lower brachials may be smaller and of a different shape, and they may not start till the sixth or seventh brachial or beyond, and the spines of the outer brachials may be correspondingly smaller; or the lower brachials may be quite smooth and those beyond may have slightly produced edges which are smooth or finely or strongly thorny.

P_1 is long and whip-like, of 40–60 or, exceptionally, of up to 75 segments; it is usually 15–22, sometimes as much as 26, mm. long. The first 6–12 segments are usually broader than long, or as long as broad, a little stouter than the following and roughly diamond-shaped. Their short and narrow dorsal surfaces may be raised into thorny crests. The following segments are of a regular shape and longer but not elongated: they are not so much as twice as long as broad; the more proximal may be raised dorsally into a fine thorny crest.

P_2 is usually of fewer segments: those examined were of 26–46 except for one which was of 62. The number is usually between five and ten less than that of P_1 of the same specimen. P_2 is of about the same length as P_1: it may be shorter or longer. The first 4–5 segments are usually more massive, compared with the others, than the basal segments of P_1; the others are slightly more elongated, though rarely so much as twice as long as broad.

The first genital pinnule is usually P_3 or P_4. P_3 is commonly of 16–40, sometimes of up to 60, segments. Whether it is an oral or a genital pinnule it may be of roughly the same length as P_2, but sometimes, when it is a genital, it is very much shorter and of segments which diminish rapidly in stoutness from the base to the end. P_3 is usually of anything from 5 to 20 fewer segments than P_2 of the same specimen; all but its basal segments are more elongated, being as much as, or more than, twice as long as broad.

The middle genital pinnules are of about 20–26, exceptionally more, segments; they are 10–20 mm. long, sometimes considerably longer. The outer pinnules are of about the same length or longer. In both the genital and outer pinnules the first segment is very short, the second longer but not so long as broad, the others considerably longer than broad.

The way in which the primary ambulacral furrows on the disk divide so as to provide the arms is very variable though certain arrangements appear to be more constant than others (see below).

Sacculi are abundant on the pinnules.

Along the sides of the pinnule ambulacra there may be a single continuous series of large plates, three or four to each pinnule, the distal edge of one overlapping the proximal of the next. Each is curved in the axis of the pinnule and has its outer part curved over the ambulacral furrow. Clark (1921, p. 268, fig. 378) has described them at their highest development. When they are present the tentacles contain numerous knobbed spicules. The plates may be smaller, and therefore not touching one another, or very much smaller and fewer: in some specimens the pinnules have only one or two extremely simple small plates near the end (Fig. 2 *c*). They are often entirely absent. In some specimens with reduced plates the spicules are few; if the plates are very reduced they may be absent: this is so in over twenty-five specimens of the present collection. On the other hand, it is only in one specimen that there are spicules (and they are few) and no plates. (It was, of course, only three or four pinnules of any specimen that were examined.) The presence of plates and spicules has been regarded as a sign of immaturity. The examination of the present collection has shown that it is not so, but that there does appear to be some correlation between the degree of development of the plates and spicules in a number of specimens and the locality in which they occur (see below).

The colour is very variable. The entire specimen may be straw-coloured, very light grey, flesh-coloured, pale or brilliant yellow, orange, brown or purple; the greater part of it may lack stronger colours except for bands of dark brown or purple on the cirri, or the arms (when the bands often coincide with the syzygial pairs), or the pinnules, or all three; or portions of a specimen, such as the pinnules or the distal parts of the arms, may be brown or purple or yellow. There may be great variation in the colour of the specimens of one colony as is shown by a note, made at the time of capture, describing the eight specimens from St. 42: "The animals showed a gradation of depth of colouring ranging from cream to very light grey or flesh, to pale or deep chocolate brown, to dark purple. The colour was usually least developed on the cirri, and—grading through the arms—most enforced on the pinnules; it was sometimes equally developed on all." The gonads were bright orange.

The specimens from Sts. 1948–1957, from the Bransfield Strait region, were fixed and preserved by Mr J. W. S. Marr who made many notes concerning them. He writes, from his observations on captured specimens, that the species is "very powerful and active and swims with a remarkable grace of movement". Because of its activity it breaks itself into pieces if killed in a confined space. The best results were obtained by fixing in fresh water in ample space.

The species has previously been taken from depths between 10 and 650 m.; the majority of the present collection come from between 22 and 525 m. But eight specimens were taken from 1080 m. in the Bransfield Strait (St. 177); they are all small but they possess the usual twenty arms and do not appear abnormal. A pentacrinoid larva was also taken at this station.

Number of arms. The number of arms possessed by the specimens of this collection are shown, under the localities from which they come, in the following table:

	No. examined	Arms						
		22	20	19	18	17	16	12
South Georgia	60	1	59	—	—	—	—	—
South Sandwich Island	14	—	14	—	—	—	—	—
Bransfield Strait	62	—	41	1	16	1	3	—
Graham Land region	15	—	9	1	2	—	1	2
Ross Sea	23	—	22	—	1	—	—	—

The single abnormal specimen from South Georgia, with 22 arms, has eleven radials. The twenty-one specimens with 16, 17, 18 and 19 arms from the Bransfield Strait all come from one of the eight stations made in that region (St. 1952). Twenty-two specimens with 20 arms were taken with them. They are much younger and smaller than those with abnormal numbers of arms: their longest cirri consist of 25–38, mostly 30, segments; those of most of the specimens with 16–19 arms are of 50–65 segments. Five of the six specimens with abnormal numbers of arms from the Graham Land region are of medium size, their longest cirri of 39–45 segments; one is small, its longest cirrus of 28 segments.

In the 19-armed specimen from the Graham Land region (it is from St. 180) the single arm arises from a normal radial which is followed by a regular ossicle slightly longer than the costals of the other rays. Next is a still longer ossicle with a pinnule arising from either side of it. It is succeeded by a syzygial pair with a pinnule arising from the epizygal and beyond this the arm is normal. The single arms of the 19-armed and 17-armed specimens from the Bransfield Strait are different. The second ossicle beyond the radial is shaped like an irregular axillary, and a pinnule arises from one side of it. It is followed by a very short ossicle with no pinnules, which appears to correspond with the first brachial of normal arms; after it comes a longer ossicle shaped like the second brachial of normal arms, with a pinnule on the opposite side to the first. A syzygial pair with a pinnule arising from the epizygal, on the same side of the arm as the first pinnule, comes next and thereafter the arm is normal.

Dorsal pole. In four of the specimens from the South Sandwich Islands I could see no dorsal pole; it is very small and difficult to detect in the other specimens, large and small, from the same locality. I failed to see a dorsal pole in one small specimen from South Georgia and in one from the Bransfield Strait. It was present in all the other specimens.

Cirri. Fig. 1*a* shows extreme types of cirri: in a_1 and a_2 the segments are as short as in any full-grown specimen I saw; a_3 and a_4 are of cirri of very elongated segments, though I have seen others slightly longer. The specimens from the South Sandwich Islands and South Georgia have cirri of the first type though the segments are usually a little longer than in the figure; those of the South Sandwich specimens appear to be the shorter. Two specimens from South Georgia, by no means the largest, have cirri of the second, long, type. The specimens from the Bransfield Strait and the west coast of Graham Land have cirri of the long type, though not usually so long as those figured; those from the latter locality appear to have the longer. All but two of twenty-three Ross Sea specimens have cirri of the long type. In Fig. 1*a*, 1 and 2 are from a specimen from the South Sandwich Islands, 3 and 4 from one from the west coast of Graham Land.

Division series and lower brachials. None of the bigger specimens from South Georgia have elongated axillaries and second brachials forming strong shoulders with the costals and first brachials; in the biggest the shoulders are but slight. On the other hand, most of the bigger specimens from the South Sandwich Islands and the Bransfield Strait and all from the west coast of Graham Land have axillaries and second brachials which are elongated and form strong shoulders with the costals and first brachials respectively. Among the Ross Sea specimens there are none so large and old as in the collections from the Falkland sector; nevertheless, most of them have moderately long axillaries and second brachials, but in only five do they form strong shoulders with the costals and first brachials respectively.

Ambulacral furrows on the disk. Mortensen (1918, p. 19) describes how variable is the arrangement of the ambulacral furrows on the disk, "hardly two specimens (of his collection) being alike"; Bernasconi (1932*b*, pp. 33–5, fig. 3*a–e*) gives a figure showing the different arrangements in five specimens, though the differences are slight between each of two pairs. Most of the specimens of the present large collection are well preserved with their arms bunched together so that the disk is hidden. But in ten from one locality (St. MS 71) which are preserved otherwise the disk can be seen, and in each one of them the arrangement of the ambulacral furrows is different from that in any other; in one it resembles that of two (*a* and *b*) in Bernasconi's figure. Mortensen writes: "The normal condition evidently is that each primary ambulacral furrow divides so as to provide four arms; but often one or two of them (mostly the left posterior and the right anterior) divide so as to proceed to six arms." In seven of my ten specimens the left posterior divides so as to provide six arms, but the right anteriors are very variable.

Bernasconi's five drawings show the anterior primary furrow supplying only one pair of arms: it does so in seven of my specimens.

It appears that some of the primary ambulacral furrows divide in a less variable way than others.

Side plates and spicules. Clark (1915 *a*, p. 132) thinks that the presence of well-developed plates is a sign of immaturity, and that poorly developed plates, or the absence of plates, is characteristic of mature individuals. I do not find it so in this collection. But there is a relation between locality and the presence or absence of well-developed plates: it is shown by the following table:

Locality	No. of specimens examined	No. with both plates and spicules	No. with plates only	No. with spicules only
West coast of Graham Land (Sts. 180, 182, 599)	11	7	0	1
Bransfield Strait (Sts. 170, 175, 177, 1948, 1952, 1955, 1957)	37	29	2	0
South Sandwich Islands (Sts. 363, 366, 371)	13	2	4	0
South Georgia (Sts. 39, 42, 123, 144, 148, 149, 152, 156, MS 71)	34	0	5	0

It is not only a question of numbers: the degree of plating varies as well. Of the seven specimens with plates from the west coast of Graham Land five are heavily plated; of the twenty-nine from the Bransfield Strait at least thirteen are heavily plated. The six specimens having plates from the South Sandwich Islands all have very small ones (the size of the largest is shown in Fig. 2*b*): in three of them the greatest number of plates in one pinnule is two, and they are minute and near the tip. In the five specimens from South Georgia possessing plates they are as small as, or smaller than, those of the South Sandwich specimens. In three of them there are two or three very reduced plates near the tips of some pinnules but none in others. So it is probable that if a larger number of pinnules of every South Georgia specimen were examined the proportion of individuals with plates would be found to be higher: but they would be very small plates, few in number and unevenly distributed. It is, at least, quite certain that none of the South Georgia specimens has even moderately developed plates; nor were spicules seen in the tentacles of any.

Although the South Sandwich specimens have plates nearly as small as those from South Georgia, two of them do have spicules in the tentacles as well and so, in this way, stand intermediately between the South Georgia population and that of the Bransfield Strait and the west coast of Graham Land where most of the specimens with plates have spicules too.

From these facts it would appear that in this sector of the Antarctic the *Promachocrinus kerguelensis* living in lower latitudes are most often without plates and always devoid of spicules, but that a small proportion have very reduced plates, few in number, on at least some of their pinnules; that the majority of those living in high latitudes have big plates along the entire lengths of the pinnules and many spicules in the tentacles; and that those living intermediately are intermediate in character. But Mortensen (1918, p. 19) found no plates, not only in four specimens from South Georgia, but in sixteen from the east side of Graham Land. On the other hand, Grieg (1929*a*) described the pinnules of seven specimens from the Bransfield Strait as having well-developed cover-plates.

The pinnules of thirty-eight Ross Sea specimens, twenty from the present collection and eighteen from the National Antarctic and British Antarctic Expeditions, were examined. Thirteen have plates along the ambulacra and spicules in the tentacles; in eight the plates are strongly developed, in five they are small and scattered. Another thirteen have small and scattered plates but no spicules. One specimen has spicules in the tentacles and no plates along the pinnule ambulacra; eleven have neither plates nor spicules. Two pinnules of a small Challenger specimen from Kerguelen were examined. One has a single diminutive plate near the tip, the other none.

That the presence of highly developed plates and many spicules is not a sign of immaturity is shown by the following table (p. 145), in which forty-six specimens from the Bransfield Strait and the West Graham Land region are arranged in order of age, so far as that is shown by the number of segments comprising their longest cirri.

The table shows that it is not generally the immature but the larger that have the most highly developed plates. Specimens taken from one place may vary in the degree of their plating: for example, the smaller of the three specimens from St. 175 has highly developed plates and many spicules while the other two have none.

Although Minckert (1905, p. 499, fig. 2) described *P. vanhöffenianus* as being distinguished from *P. kerguelensis* by, among other things, the possession of a skeleton along the pinnule ambulacra, his drawing, to illustrate the plating, shows no plates but a reticulation in the ambulacral lappets such as I have seen in a large number of specimens. It is formed of pigment. Hartlaub (1912, p. 485) describes the same appearance. I have not noted it as present in specimens from South Georgia, but as being of frequent occurrence in those from the South Sandwich Islands, the Bransfield Strait, the region west of Graham Land, and the Ross Sea. It may occur together with, or in the absence of, plates; if the former, in such a way as to suggest to me that it follows a reduction in the size of the plates.

Florometra mawsoni A. H. Clark (Plate III, fig. 2)

Solanometra antarctica (part) Clark, 1913, p. 61.

Promachocrinus (*Promachocrinus*) *kerguelensis* (part) Clark, 1915*a*, p. 130 (bottom of page), pl. iv, figs. 1 *a*, *b*.

Florometra mawsoni Clark, 1937, pp. 10–14.

St. 180. 11. iii. 27. Schollaert Channel, Palmer Archipelago. 160–330 m. Gear OTL. Bottom: mud and stones. One specimen.

St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago. 64° 20′ S, 63° 01′ W. 160–335 m. Gear OTL. Bottom: mud. Two specimens.

Specimen	Longest cirrus		Well-developed plates, many spicules	Small plates, spicules	Small plates, no spicules	Spicules, no plates	No plates, no spicules
	No. of segments	Length, mm.					
177 S2	22	—	−	+	−	−	−
177 S4	*c.* 22	<20	−	+	−	−	−
175 S1	24	20–25	+	−	−	−	−
1957	24	—	−	−	−	−	+
1952–8	25	—	+	−	−	−	−
177 S5	*c.* 25	25	−	+	−	−	−
1955	26	—	+	−	−	−	−
1957	27	—	−	−	−	−	+
182 M1	28	>40	−	−	−	−	+
180 M1	28	45	−	+	−	−	−
1952–7*g*	28	—	−	+	−	−	−
1952–7*h*	28	—	−	+	−	−	−
180 M2	29	—	−	−	−	−	+
1948	30	—	−	−	−	−	+
1952–2	30	—	−	+	−	−	−
1952–6*b*	30	—	−	+	−	−	−
1952–6*c*	30	—	−	+	−	−	−
1952–6*d*	30	—	−	+	−	−	−
1952–7*c*	30	—	−	+	−	−	−
1952–7*i*	30	—	−	+	−	−	−
170 S2	*c.* 30	27	+	−	−	−	−
170 S5	*c.* 30	25–30	+	−	−	−	−
1952–6*e*	31	—	−	+	−	−	−
1952–7*f*	31	—	−	+	−	−	−
175 M1	>31	>55	−	−	−	−	+
1955	32	—	+	−	−	−	−
170 S3	33	38	+	−	−	−	−
170 S4	33	35	+	−	−	−	−
175 S2	*c.* 33	*c.* 45	−	−	−	−	+
170 S1	34	30	+	−	−	−	−
1952–4	34	—	+	−	−	−	−
180 M4	36	55	−	−	−	+	−
170 LM	38	60	−	−	+	−	−
1952–6*a*	38	—	+	−	−	−	−
182 M2	39	*c.* 70	+	−	−	−	−
182 M3	39	*c.* 70	+	−	−	−	−
180 M3	42	55	−	+	−	−	−
599 M1	42	*c.* 50	+	−	−	−	−
182 M5	46	*c.* 80	+	−	−	−	−
182 L1	54	110	+	−	−	−	−
1952–1	58	—	+	−	−	−	−
1952–3*a*	60	—	+	−	−	−	−
1952–3*b*	61	—	+	−	−	−	−
1952–5	61	*c.* 130	+	−	−	−	−
1952–9	63	>115	+	−	−	−	−
1952–7*b*	64	>110	+	−	−	−	−

Note. Each specimen appears in the table under the number assigned to it in the study of this collection. In each the first number (e.g. 177 in 177 S2 or 1952 in 1952–7*g*) is the number of the station from which the specimen came.

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago. 64° 56′ S, 65° 35′ W. 130–100 m. Gear DLH, NRL. Bottom: mud, stones and rock. One specimen.

St. 599. 17. i. 31. Adelaide Island. 67° 08′ S, 69° 06½′ W. 203 m. Gear DLH. Bottom: no data. Four specimens.

St. 1652. 23. i. 36. Ross Sea. 75° 56·2′ S, 178° 35·5′ W. 567 m. Gear DRR. One very young specimen.

St. 1660. 27. i. 36. Ross Sea. 74° 46·4′ S, 178° 23·4′ E. 351 m. Gear OTL. Bottom: mud. One very young specimen.

I had written a full description of this species before knowing that Mr Clark had found it in the Australasian Antarctic collection and described it. I think it useful to add the following remarks and to publish the figures I had prepared.

The arms of the eight specimens vary in length from 50 to 110 mm.

I find the cirri to be XL–LXV, 16–31, but mostly 24–26. The most elongated segments, the fourth to seventh, are not quite so elongated as in Clark's description; the most distal are slightly longer: they are longer than their distal widths.

Clark describes how the distal edges of the radials are considerably produced outwardly at the sides. In all but one, a small specimen, of the present collection the distal edge of the radial is produced into a thin lip-like frill which may stand out at right angles or be curved farther backwards. It has the appearance of being formed of a row of spines all but the points of which are connected by a web, and it is stronger on the sides than in the mid-line. The distal edge of the costal is produced into a similar thorny frill.

Fig. 3 *b–e* shows the shapes of the brachials. The spinous processes on the distal edges of the lower brachials give the animal a very characteristic appearance. They may be small on, or absent from, the first and second brachials. They are strongest between the first and second syzygial pairs where they stand out at right angles to the arm. On the brachials beyond the third syzygy they are forwardly directed but still coarse and strong. (They are stronger than appears in Fig. 3 *d* which, being a dorsal view, does not show how strongly the edge of one segment overlaps the beginning of the next.) They persist to the end of the arm.

On one arm of one specimen there is only a single ossicle, larger than the normal first or second brachial, between the axillary and the first syzygial pair.

In the smallest adult specimen P_1 is of 25 segments, in the others of 28–39 segments and up to 12 mm. long. P_2 has from 24 to 38 segments. P_3 may be a whip-like oral pinnule, with heavier basal segments than the others, but in most of the specimens it is a genital pinnule.

The earlier genital pinnules may be considerably shorter than the orals. The number of segments in the genital pinnules varies from 14 to 23, the proximal usually having a smaller number than the distal. All but the first two segments are longer than broad. The distal edge of each is produced into a row of spines. The distal pinnules are like the genitals but slightly longer, of 20–30 segments.

The disk is naked.

Sacculi are abundant.

In some of the specimens there is a single row of small fenestrated plates along each side of the ambulacral furrow in a few segments near the tips of the pinnules. They vary in number from about two to ten and when the bigger number is present the more proximal are very small, the distal larger (Fig. 3 *h*). In some specimens there are spicules in the tentacles. Both plates and spicules may be absent or one or both may be present.

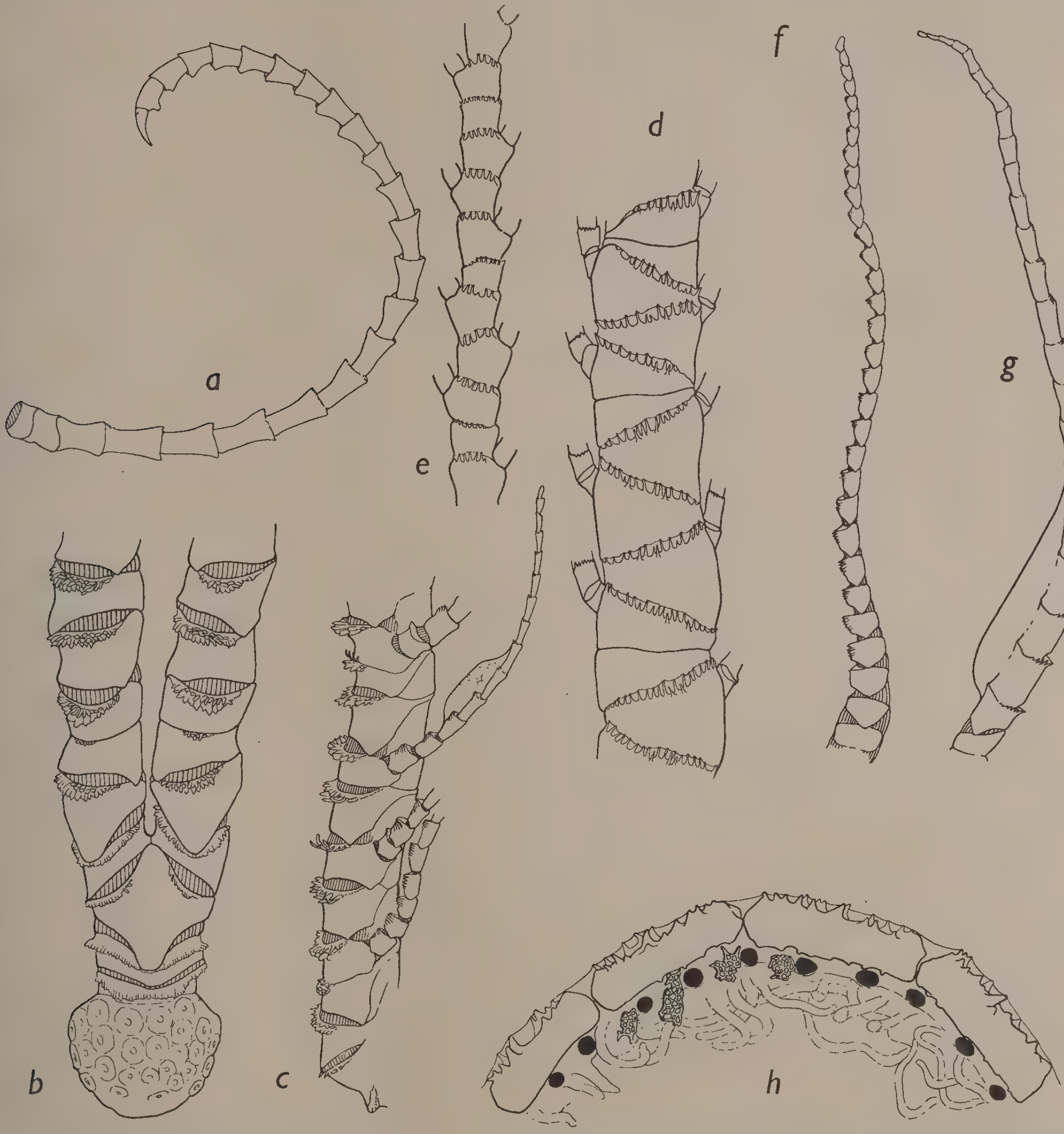

Fig. 3. *Florometra mawsoni*. *a*, cirrus, ×7. *b*, centrodorsal and proximal part of a ray, ×7. *c*, first to eleventh brachials in profile and P_3, ×7. *d*, brachials beyond third syzygy, ×11. *e*, distal brachials, ×11. *f*, P_1, ×11. *g*, P_{12}, ×11. *h*, side-plates of a distal pinnule, ×53.

There is no information as to the colour of the specimens in life. In spirit they are pale straw with a dark bluish tinge in places. In one specimen the bluish tinge is confined to the outer pinnules. In the others it occurs on some of the brachials and the basal segments of some of the pinnules: it is always strongest on the brachials of the syzygial pairs and the bases of the pinnules arising from them and is sometimes present only on these ossicles. In one specimen the syzygial pairs stand out as dark bands along the whole length of the arm, darkest along the middle arm. There is no blue coloration on the calyx, the centrodorsal or the cirri. In one specimen the centrodorsal and radials are yellow.

One of the specimens was infested with two cysts of *Myzostomum cysticolum.*

DISTRIBUTION. There are in the British Museum collection eight specimens of this species from the Ross Sea which had been labelled *Anthometra adriani* or *Solanometra antarctica.* One is from Discovery Winter Quarters and another two are Discovery specimens labelled "Mt Erebus and Terror". The remaining five are Terra Nova specimens (see p. 220).

The species is then known from the coast of the continent in the Ross Sea, Indian Ocean and Weddell Sea sectors of the Antarctic; it is not known from any of the outlying islands.

Florometra antarctica, n.sp. (Plate III, fig. 3)

St. 180. 11. iii. 27. Schollaert Channel, Palmer Archipelago. 160–330 m. Gear OTL. Bottom: mud and stones. Two specimens.

St. 599. 17. i. 31. Adelaide Island. 67° 08′ S, 69° 06½′ W. 203 m. Gear DLH. Bottom: no data. One specimen.

DESCRIPTION. One of the three specimens is nearly complete and has arms about 95 mm. long. In another, less complete but more massive, the arms must have been over 100 mm. long. The third specimen is smaller, with arms so broken that it is impossible to estimate their length when complete.

The centrodorsal is a large rounded cone closely covered with cirrus sockets arranged in regular or fairly regular columns (Fig. 4 *a*). The dorsal pole is rounded and rough in two of the specimens, sunken in the third.

Cirri LXIX–LXXVII, 23–32, usually 27–32. The cirri are long and strong, much longer in proportion to the length of the animal than in *Florometra mawsoni*, particularly so in the largest specimen. The first two segments are short, the third is about as long as broad. The fourth is twice as long as broad and fairly strongly waisted. The fifth to about the ninth are about two-and-a-half times as long as broad and faintly waisted. Beyond the ninth the segments gradually decrease in length though all are longer than broad. The distal segments possess a strong dorsal spine, the apex of which is subterminal. The opposing spine and the terminal claw are strong (Fig. 4 *b*).

In the specimen with arms 95 mm. long the basal rays are visible externally as small triangular plates (Fig 4 *a*). In the other two specimens, the largest and the smallest, I can see only four basal rays.

The radials are short, especially in the mid-line, because their distal edges are strongly concave. They are in apposition for the greater part of their length but the distal corners are free. The distal edge may be smooth or raised into a low finely-thorny ridge. The costals are longer than the radials, not in apposition laterally. The distal edge of each is raised on either side of the incision by the axillary into a thorny lip at right angles to the surface of the ossicle.

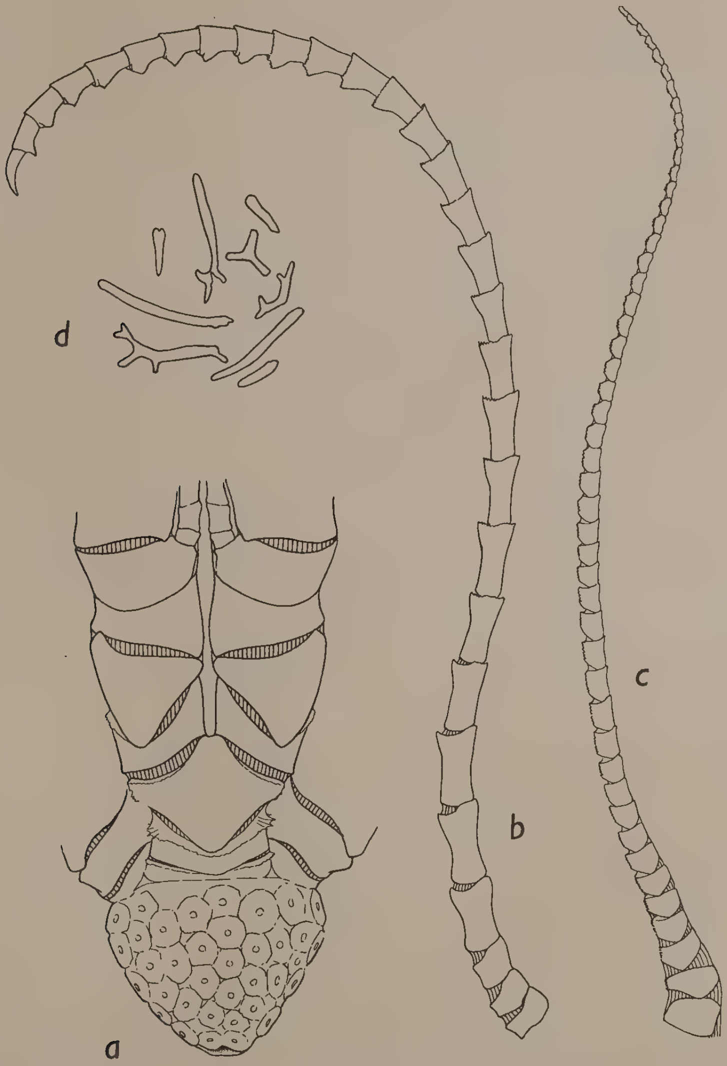

Fig. 4. *Florometra antarctica. a*, centrodorsal and parts of three rays, ×7. *b*, cirrus, ×7. *c*, P_1, ×11. *d*, spicules from tentacles of distal pinnules, ×114.

The axillaries and the first and second brachials are of the shapes shown in Fig. 4 *a*. The axillary is wider than the costal and forms a shoulder where it incises it; its distal edge is smooth but there are small spines on the free outer portions of its proximal edges. The inner edges of the first brachials are much shorter than the outer; they do not meet, or at most their corners meet, above the axillary; the distal edges are smooth or finely thorny. The second brachial forms a slight shoulder where it incises the first; there may be fine spines along part of its proximal edge but its distal edge is smooth.

The first syzygy normally occurs between the third and fourth brachials but in one specimen it is between the fourth and fifth brachials on one arm, between the tenth and eleventh on another. The second syzygy is usually between the ninth and tenth brachials but it also occurs between the eighth and ninth and the tenth and eleventh. Syzygies are numerous beyond the second with one to four brachials between the pairs.

The brachials between the first and third syzygial pairs are nearly rectangular, wider than long; those beyond are at first wedge-shaped and then triangular, a little broader than long; farther out on the arm they become rectangular, at first broader than long, then as long as broad.

In the two large specimens the distal edges of the brachials between the first and second syzygies are smooth. The first one to three of these brachials are smooth in the small specimen but the others are raised distally, in the mid-line only, into a group of spines much smaller and lower than those of *F. mawsoni* but, like them, standing out at right angles to the arm. The distal edges of the brachials beyond the third syzygy are the same in all three specimens: they are produced into a row of strong forwardly directed spines.

The oral pinnules are longer and composed of a greater number of segments than in *F. mawsoni* and the first genital pinnule is farther out on the arm. P_1 is of 44–50 segments, 16 mm. long (Fig. 4 *c*); P_2 of 38–45 segments, 15–16 mm.; P_3 of 35–43 segments, about 13 mm. None of the segments of the oral pinnules is much longer than broad; the proximal have spiny dorsal carinations which become reduced to low rounded protuberances on the segments at the tip of the pinnule. The first genital pinnule is P_4 or, more often, P_5. P_5 is of about 23 segments and 11 mm. long; the gonad lies along the fourth to the tenth or eleventh segments. The other genital pinnules are of between 23 and 30 segments and up to 16 mm. long; the gonads usually lie along the third to eighth segments. All but the first two segments of the genital pinnules are considerably longer than broad. Their distal edges are beset with fine spines.

The disk is naked. Sacculi are abundant. None of the specimens shows any trace of an ambulacral skeleton. In the largest specimen there are many spicules, some smooth and rod-like and others branched, in the tentacles of the distal segments of the outer pinnules (Fig. 4 *d*).

The specimens are of a pale straw colour in spirit, darker on the pinnules than elsewhere. There is a yellowish tinge on the distal parts of the cirri and pale brown spots on the gonads and the tissues on the inner sides of the arms. Some of the brachials have a bluish tinge along the sides.

One of the specimens has a large cyst of *Myzostomum cysticolum* v. Graff lying between the bases of a pair of its arms with its lower extremity resting on the disk.

Florometra antarctica is distinguished from *F. mawsoni* by its considerably longer oral and genital pinnules which are composed of a greater number of segments. The distal edges of the lower brachials are not everted into strong spiny ridges at right angles to the dorsal surface as in *F. mawsoni*. The cirri, although they do not comprise more or many more segments than those of *F. mawsoni*, are much heavier and longer.

Genus Anthometra Clark

Anthometra adriani (Bell) (Plate III, fig. 4)

Antedon adriani Bell, 1908, p. 4, pl. ii; 1917, p. 2.
Promachocrinus (*Anthometra*) *adriani* Clark, 1913, p. 60; 1915 *a*, pp. 135–7, pls. vi–vii.
Anthometra adriani Mortensen, 1918, p. 18; Clark, 1921, many references including description of side plates (p. 270) and of pentacrinoid young (pp. 557–9, fig. 938); Mortensen, 1925 *b*, p. 2; Gislén, 1928, p. 11; Clark, 1929, p. 662; Grieg, 1929 *a*, p. 4; John, 1937, p. 10; Clark, 1937, pp. 14–16.

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago. 64° 56′ S, 65° 35′ W. 130–100 m. Gear DLH, NRL. Bottom: stones, mud and rock. Two specimens.

St. 1660. 27. i. 36. Ross Sea. 74° 46·4′ S, 178° 23·4′ E. 351 m. Gear OTL. Bottom: mud. One broken specimen.

St. 1952. 11. i. 37. Between Penguin Island and Lion's Rump, South Shetlands. 367–383 m. Gear DRR. Bottom: soft mud. Nine specimens.

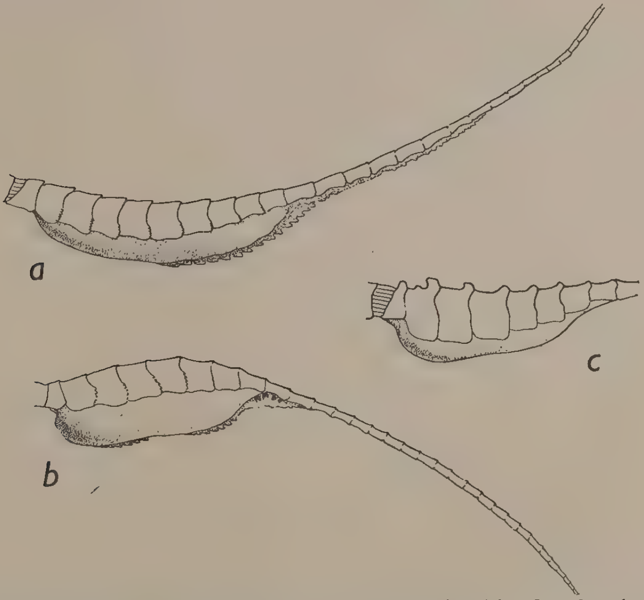

Fig. 5. *Anthometra adriani*. *a*, a male genital pinnule from the side. *b*, a female genital pinnule from the side. *c*, the same obliquely from above. All ×7.

It appears from my own counts and those of others that the cirri of large specimens may be numerically described as follows: L–LXX, 60–86, up to 90 mm. long.

Gislén says that some of the segments of the proximal pinnules are expanded and that it thus "forms a transition to the Isometrinae". It is the segments of the genital pinnules along which the gonad lies that are expanded, and they are a little more expanded in the female than the male. Figures are given (Fig. 5): the female pinnule is from a well preserved Terra Nova specimen with nearly complete arms which are

250 mm. long, a much greater length than any previously recorded; the male pinnule is from a smaller specimen.

One of the specimens from St. 190 is infested with a *Myzostomum* on the disk.

Genus **Solanometra** A. H. Clark

Solanometra antarctica (P. H. Carpenter)

Antedon antarctica P. H. Carpenter, 1888, p. 144, pl. i, figs. 6 *a–d*, 7 *a*, *b*, pl. xxv.
Antedon australis P. H. Carpenter, 1888, p. 146, pl. xxvi, figs. 4, 5, pl. xxvii, figs. 14–20.
Promachocrinus (*Solanometra*) *antarctica* Clark, 1915 *a*, p. 135—list of earlier references and synonymy.
Solanometra antarctica Clark, 1937, p. 9.

There are no specimens of this species in the present collection.

Bell records it (as *Antedon antarctica*) from the Ross Sea both in his Discovery (1908) and Terra Nova (1917) reports. I have re-examined the specimens and find that not one of them is *Solanometra antarctica*.

The species is known only from the Challenger specimens taken near Heard Island (of which there are six in the British Museum collection, three each from Sts. 150 and 151), and from the Australian Antarctic Expedition's collection from near the coast of Adélie Land on the Antarctic continent.

Subfamily *ZENOMETRINAE*

Genus **Eumorphometra** A. H. Clark

Eumorphometra aurora n.sp. (Plate IV, fig. 1)

St. 160. 7. ii. 27. Near Shag Rocks. 53° 43′ 40″ S, 40° 57′ W. 177 m. Gear DLH. Bottom: grey mud, stones and rock. One specimen.

Description. All the arms are broken off at what I judge to be about three-quarters of their length; the parts remaining are composed of about 30 brachials and are nearly 20 mm. long.

The centrodorsal is a rounded cone not so high as it is broad at the base. The ventral edge is produced into very low and wide corners interradially. The cirrus sockets are arranged in ten columns, one close against another, the arrangement of which is regular but for the most ventral circle which is composed of fourteen.

Cirri *ca*. XLI, 17–28. They increase in size from the apex of the centrodorsal to the edge. Those around the dorsal pole are of about 17–19 segments and short; the next circle are longer, of 21–23 segments; the outermost are of 27 or 28 segments and up to 10 mm. or more in length, about twice as long as the apical (Fig. 6 *a*). The first three segments of the cirri are broader than long, the fourth is as long as broad, and the fifth to the eighth or ninth are slightly longer than broad. All these have the distal end slightly flared, more strongly on the dorsal than the ventral side, so that they are a little wider distally than at the base. The more distal segments are about as long as broad. Their dorsal sides are raised into low keel-like protuberances highest near the end of the segments, making them wider distally than proximally. The terminal claw is short and the opposing spine small.

The radials are nearly rectangular and fairly long, about half as long as broad (Fig. 6 *b*). The distal half is half-cup shaped. In profile the proximal half makes only a slight angle with the dorsoventral axis but the distal half bends sharply outwards. The costals are not quite so long as the radials; they are widely separated from each other and are not deeply incised by the axillaries. The axillaries are slightly longer than broad. The first and second brachials are of the shape shown in Fig. 6*b*; the former are widely separated. The distal edges of the radials, costals, axillaries and the first and second brachials are raised into very fine spines.

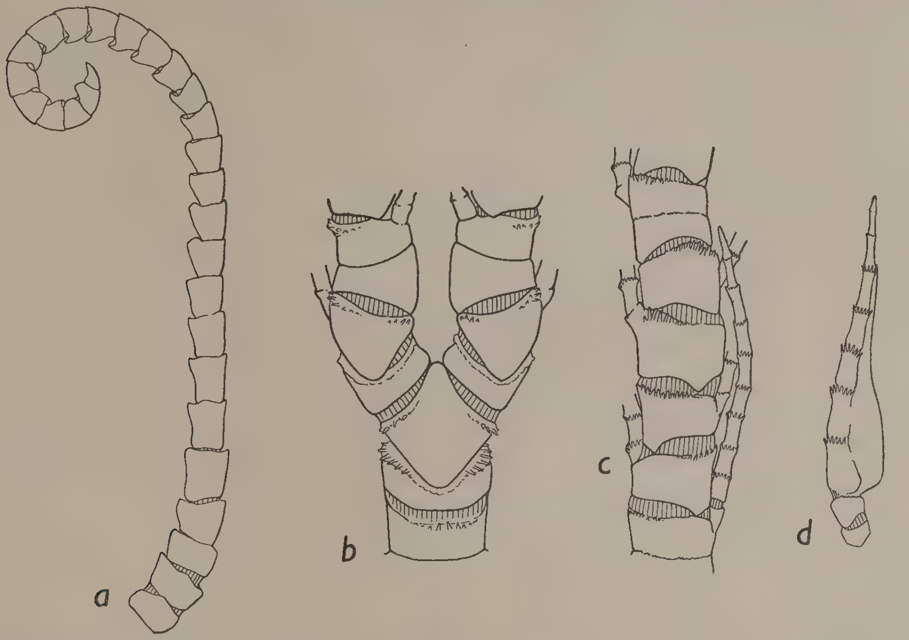

Fig. 6. *Eumorphometra aurora*. *a*, cirrus. *b*, proximal part of a ray. *c*, fourth to tenth brachials and P_a. *d*, P_6 from the side. All ×13.

Syzygies occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and thereafter with intervals of two brachials between each syzygial pair.

The fifth to eighth brachials, between the first and second syzygies, are nearly rectangular, about one-and-a-half times as broad as long (Fig. 6 *c*). Those between the second and third syzygies are wedge-shaped and longer than broad. The more distal brachials are longer on one side than the other, slightly longer than broad. The distal edges of all the brachials beyond the first syzygy are faintly raised and produced into short spines; they are most conspicuous on the distal brachials, but are much shorter and less conspicuous than those of *E. hirsuta*.

There is no strong contrast between the different kinds of pinnules. In all, the distal edges of the segments are faintly flared out and produced into spines; the flare is not strong enough to give the joints a swollen appearance. P_1 is slender and tapers evenly from the base to the tip. It is 4–5 mm. long, of 13 rounded segments all but the first two or three of which are longer than broad, the distal more so than the proximal; the distal are up to three times as long as broad. P_2 is similar to P_1 but of fewer segments and shorter, of 8–9 segments, about 3 mm. long. It tapers more rapidly and its distal segments are more elongated. In the genital pinnules the first two segments are short, the others longer than broad, the middle segments being more elongated than in the oral pinnules. P_3 is the first genital pinnule; it is of 8–9 segments like P_2 but is slightly longer, 3–4 mm. long. It bears a large egg-shaped gonad on the third to fifth segments: a testis, for the specimen is a male. The genital pinnules extend to P_7 or P_8 (Fig. 6 *d*). They are all of about the same number of segments as P_3, but the distal are a little longer, up to 5 mm. long; their gonads are more fusiform being along the third to sixth segments. The pinnules immediately beyond the genitals are about 5 mm. long and of about 12 segments, the first two short, the others considerably longer than broad. There are no complete outer pinnules left.

The disk is naked. Sacculi are few and inconspicuous.

Along the pinnule ambulacra there are small rods, three to each segment, which are perforated, forked or branched at the end. They are very reduced side-plates and are better developed along the middle than the proximal segments. At the ends of some, but not all, there are equally reduced cover-plates. Both are similar to, but more reduced than, those of *Phrixometra nutrix* (Fig. 11*e*).

The specimen is white in spirit.

Mr A. H. Clark has kindly made for me a direct comparison of this species and *Eumorphometra concinna*. *E. aurora* is considerably larger, its centrodorsal is lower and broader with more numerous cirrus sockets more irregularly arranged; its longer cirri have more segments; its radials and axillaries are longer; the elements of its division series and its brachials do not have their central portions abruptly elevated and prominently spinous as in *E. concinna*.

I have been able to compare *E. aurora* directly with *E. hirsuta*. *E. aurora* is far less spinous; the shapes of the elements of the division series and of the first two brachials are quite different in the two species. The cirrus sockets of *E. hirsuta* are in about fifteen irregular columns.

E. aurora is easily distinguished from *E. fraseri* by its smaller number of cirrus segments; and from *E. marri* by the facts that its cirrus sockets are in columns not alternating rows, that P_1 is not much more massive than P_2, and that the segments of the lower genital pinnules carrying the gonads are not expanded.

Eumorphometra fraseri, n.sp. (Plate IV, fig. 2)

St. 1955. 29. i. 37. North of South Shetland Islands. 61° 35·1′ S, 57° 23·3′ W. 440–410 m. Gear DRR. One specimen.

Description. No arm is complete; the longest is of 44 brachials, 28 mm. long. The centrodorsal is a high and pointed cone with a sharp and rough dorsal pole. The ventral edge of the centrodorsal is produced into low corners interradially. It is thickly covered with cirrus sockets.

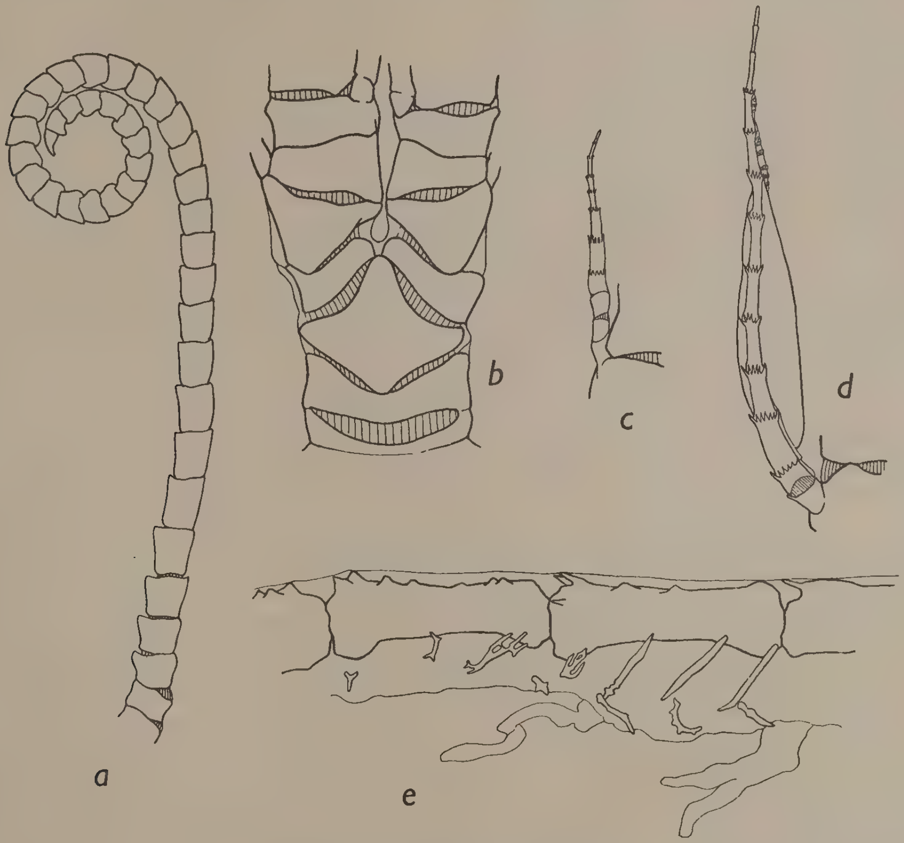

Fig. 7. *Eumorphometra fraseri.* *a*, cirrus. *b*, proximal part of a ray. *c*, P_a. *d*, P_7. *e*, ambulacral skeleton of distal pinnule. *a–d*, ×13; *e*, ×66.

Cirri XLV, 34–40, arranged in slightly irregular closely placed columns, three to each radius, two to four cirri in each column. The peripheral cirri appear to be slightly longer than the more apical, about 12 mm. long.

The first, second and third segments are about twice as wide as long (Fig. 7 *a*). The third segment is wider distally than proximally, the greater width being on the dorsal side, and it is waisted, more strongly on the dorsal than the ventral side. The fourth and fifth segments are of similar shapes but the fourth is more than half as long as wide and the fifth is nearly as long as wide. The sixth to the tenth are slightly longer than wide; they are wider distally than proximally but not so much so as in the third to fifth segments: they are of a more regular shape, not waisted. The eleventh and twelfth segments are as long as broad. The remaining segments are broader than long. Beyond about the fifteenth the dorsal edge becomes curved instead of straight and on the distal segments it is produced into a low, strongly rounded dorsal spine. The opposing spine is strong and stands out at right angles; the terminal claw is strong.

The cirri, in common with the rest of the proximal half of the specimens, were orange-yellow in life. The colour is lost in spirit. The first five or six segments are lighter than the remainder. On many cirri the eighth to tenth segments are much darker, being a rusty yellow, than the others.

The radials are short narrow strips with concave and everted distal margins (Fig. 7*b*). The costals are short, about one-sixth as long in the midline as they are wide. They are in contact laterally. They are deeply incised by the posterior projection of the axillaries which makes shoulder-like projections with them. The axillary is a little broader than long. Its proximal edges are nearly straight whereas the distal are deeply concave; it follows that the posterior projection is broadly rounded, the anterior sharper. The edges of the costals and axillaries are everted and finely thorny.

Syzygies occur between brachials 3 + 4, 9 + 10 and 14 + 15, beyond which they are numerous, the pairs being separated by two to three, or exceptionally four, brachials.

The first brachial is short with a slightly longer external than internal edge; its distal margin is slightly incised by the second brachial. The second brachial is approximately an equilateral triangle; the distal edge is slightly concave. The internal edge of the first syzygial pair is considerably longer than the external.

The fifth to eighth brachials, between the first and second syzygial pairs, are roughly rectangular, somewhat broader than long. They are alternately longer on one side than the other. For some distance beyond the second syzygy the brachials are triangular and about as long as broad. Farther out on the arm they are quadrangular with one side, alternate sides in successive brachials, considerably longer than the other; they are slightly longer than broad. The distal edges of the lower brachials, between the first and the third or fourth syzygial pairs, are produced into single rows of strong tooth-like spines; those of the more distal segments are smooth.

P_1 and P_2 are incomplete or hidden. P_a and P_b are each about 5 mm. long. P_a is of 11 segments and tapers to the distal end (Fig. 7 *c*). The first segment is as long as broad; the second and third are slightly longer than broad. The fourth and fifth are about twice as long as broad. The slender distal segments are longer, three or more times as long as broad. The distal edges of the more distal segments are produced into strong spines. The ventral side of the pinnule is thickly covered with sacculi, though there is no ambulacral groove.

P_b is usually an oral pinnule of 9 slender evenly tapering segments. The first is about as long as broad, the second slightly longer. The remainder are elongated: the third is twice, the fourth about three times, as long as broad; the fifth to ninth are about five times as long as broad. The distal edges of the segments are produced into a small number of spines; the entire dorsal edge of one or two of the lower segments may be rough with spines.

On some arms P_b is a genital pinnule.

P_3 is usually the first genital pinnule and it carries a large fusiform testis—for the specimen is a male—along the third to seventh segments. A P_3 which is of 9 segments and 5 mm. long appears to be nearly complete. The first two segments are short, the remainder elongated, the fourth and succeeding segments being four or more times as long as broad. In the other genital pinnules the segments are not so elongated. The genital pinnules extend to P_{10} or P_{12}; in the middle genital pinnules the gonad lies along the third to eighth segments.

P_7 may be taken as an example (Fig. 7 *d*). It is of 13 segments and 6 mm. long. The first two segments are short. The third to eighth increase from two to four times as long as broad. The distal end of each is flared out into a thorny cup around the base of the next; the base of each is swollen to a less extent. The distal segments are longer, more regular and more slender.

The outer pinnules are of about 18 segments and 8 mm. long. The first two segments are short, the third and fourth longer than broad, the remainder about twice as long as broad. Their distal edges are thorny.

The disk cannot be seen.

Sacculi are numerous and conspicuous along the pinnule ambulacra.

The pinnule ambulacra are lined by rod-like side plates, three to each segment. They are mostly simple smooth rods but they may be knobbed and they may have forked or perforated ends; at the end of some pinnules they are shorter and have a different, more plate-like form (Fig. 7 *e*). Strongly knobbed spicules occur in the tentacles.

The following is a colour note made at the time of capture: "Proximal half, including cirri, orange yellow; distally the arms and pinnules are much banded with delicate grey, producing a dark effect."

E. fraseri is distinguished from the other species of the genus by its greater number of cirrus segments. Apart from this difference the cirri are generally similar to those of the other species.

Eumorphometra marri, n.sp. (Plate IV, fig. 3)

St. 1948. 4. i. 37. East of Clarence Island, 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. One specimen and fragments of another.

DESCRIPTION. The single specimen is in good condition with arms of about 60 brachials, 25 mm. long.

The centrodorsal is hemispherical with a rounded dorsal pole; its ventral edge is straight. The cirrus sockets are arranged in two or three closely placed alternating rows.

Cirri XLII, 23–28; the apical are of fewer segments and shorter than the peripheral. The first segment is nearly twice as broad as long; the second is two-thirds as long as broad (Fig. 8 *a*). The third and fourth are as long as broad. The fifth is slightly longer than broad. The sixth to eighth are shorter than the fifth, but each is longer than broad. All the remaining segments are slightly broader than long. From the twelfth onwards they are wider distally than proximally and the dorsal edge is rounded but it is not raised into a keel or spine. The opposing spine is strong; it has the shape of an equilateral triangle and arises from the entire dorsal edge of the penultimate segment. The terminal claw is moderately strong and curved.

The radial is short with a concave distal edge; its width is six times the length in the midline (Fig. 8 *b*). The costal is four times as wide as the lateral, greatest, length. It is moderately deeply incised by the axillary. The costals are not in apposition. The axillary is one-and-a-third times as broad as long. The proximal edges are faintly concave, the posterior projection broadly rounded; the distal edges are deeply concave so that the anterior projection is narrow and pointed. The radials, costals and axillaries are smooth.

Syzygies are numerous. The positions of the first three are 3 + 4, 9 + 10, 14 + 15; the pairs occur thereafter at intervals of one to three, usually two, brachials.

The first brachial is short with a longer exterior than interior edge; it is slightly incised by the second. The second is a little broader than long with a broadly rounded posterior projection and a concave distal edge. Both brachials are smooth. The interior edge of the first syzygial pair is considerably longer than the exterior. The brachials between the first and second syzygies are slightly broader than long. The fifth is rectangular with its interior proximal corner produced backwards. The succeeding brachials are similar, with, alternately, the exterior and interior proximal corners produced backwards. They gradually change in shape so as to be wedge-like at the second syzygy. Beyond the second syzygy the brachials are triangular, a little longer than broad. Farther out on the arm they become quadrangular, with oblique proximal and distal edges, and more elongate. The distal edges of all the brachials beyond the first syzygy are everted and rough with spines.

P_1 is longer and much more massive than P_2; P_3 is the first genital pinnule. P_1 is of 14 segments, 4 mm. long, and extends as far as P_2 (Fig. 8 *c*). The segments are strong and rounded and a little longer than broad; their dorsal surfaces and distal edges are rough. P_2 is of 10 segments, 3 mm. long; all but the first segment are longer than broad: the fourth and succeeding segments are twice as long as broad. P_3 is of 10–12 segments, about 3 mm. long, and has an ambulacral furrow (Fig. 8 *d*). The first two segments are short. The third to seventh, along which the gonad lies (a testis, for the specimen is a male), are considerably longer. They are slightly expanded. The third is as long as broad. The fourth is as wide but slightly longer. The fifth is not so wide as the fourth; it is longer than broad. The sixth is narrower and about twice as long as broad; the seventh is more than twice as long as broad. The remainder are narrow and elongated, about three times as long as broad. All the segments have strongly everted and spinous distal edges; the spines are strongest on the aboral edge of the expanded segments.

The genital pinnules extend to P_{18}. They resemble P_3 except that the expansion of the segments along which the testis lies gradually lessens; it disappears about P_{10}

(Fig. 8 *e*). The genital pinnules gradually increase in length and number of segments; P_4 is of 10 segments, 3·5 mm.; P_{10} of 13 segments, 4·5 mm.; P_{18} of 14 segments, 5 mm. On the adoral side of each testis, opposite the third segment of the genital pinnule, there is a small papilla through which presumably the spermatozoa pass to the outside.

The distal pinnules are of 17 segments, all but the first two of which are two to three times as long as broad; they have everted and spinous distal edges.

Sacculi are very numerous and conspicuous, regularly arranged along the pinnule ambulacra.

There are reduced rod-like side-plates along the pinnule ambulacra; they may be simple smooth rods, or they may be knobbed, or have branched or reticulated ends. There are no spicules in the tentacles.

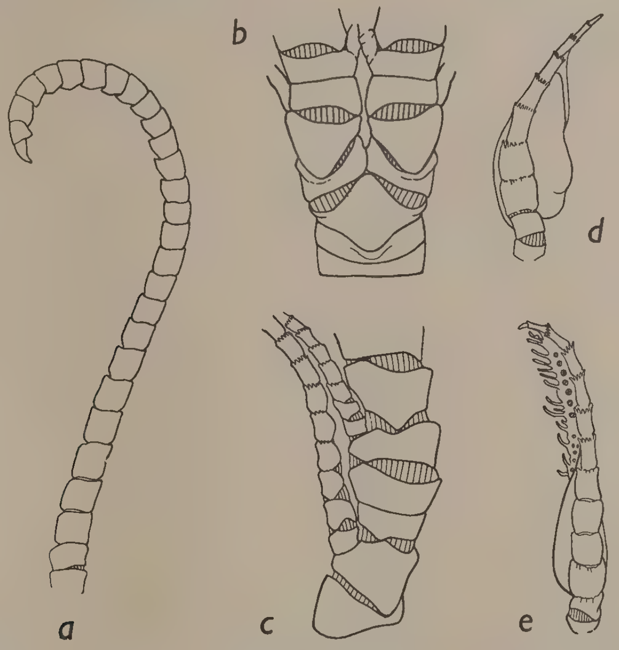

Fig. 8. *Eumorphometra marri*. *a*, cirrus. *b*, proximal part of ray. *c*, lower brachials and portions of P_1 and P_2 from side. *d*, P_3. *e*, P_{10}. All ×13.

E. marri is distinguished from the other species of the genus by having its cirrus sockets arranged in two or three alternating rows, not in columns; by the fact that P_1 is not only longer but much more massive than P_2; and by having the segments of the lower genital pinnules which carry the gonads slightly expanded.

Eumorphometra hirsuta (P. H. Carpenter)

Antedon hirsuta P. H. Carpenter, 1888, p. 188, pl. xxxi, fig. 5.

This species is known only from the single Challenger specimen from 140 fathoms near Marion Island. It may be useful to add here a few notes based upon a re-examination of the specimen.

The cirrus sockets are arranged in about fifteen irregular columns; the columns are least regular near the ventral edge of the centrodorsal, around which there are about twenty sockets.

Cirri about XXXV, 25–30. The distal segments, from about the tenth outwards, have a rounded dorsal keel which is not shown in Carpenter's figure; it is stronger than that of *E. fraseri*.

P_1 is long, stiff and slender, of 12 evenly tapering segments, 4·5 mm. long. The first two segments are heavy and broader than long; the third and fourth are about as long as broad; the remainder are elongated and become more and more slender to the tip of the pinnule. The distal edges are thorny.

P_2, of 11 segments and about 4 mm. long, is similar. Carpenter describes it as carrying a gonad: if it is a gonad, it is very small.

The remaining pinnules arise from regenerated brachials and do not bear gonads.

Eumorphometra concinna A. H. Clark

A. H. Clark, 1915 *a*, p. 118, pl. ii, figs. 2 and 3.

This species is known from the five specimens taken by the Deutsche Südpolar Expedition in 380–400 m. off Gaussberg in the Indian Ocean sector of the Antarctic. It has not been recorded since. Upon re-examining a female co-type Mr Clark found that there were brood-pouches alongside the ovaries. Knowing of the number of brood-protecting species that I had among the Discovery collection, he immediately sent me a portion of the arm and a number of detached pinnules with permission to describe them here.

The arm fragment is from the middle of an arm and carries a few of the distal genital pinnules and the first of the outer pinnules. The distal edges of the brachials are raised into stronger spines than those of the corresponding brachials in *E. aurora*. Along the pinnule ambulacra there are reduced rod-like side- and cover-plates like those of *E. aurora*, except that some are strongly thorny.

The brood-pouches lie on the aboral side of the pinnules, nearest the arm. The walls are so thin that the contents of the pouch can be seen through them. The eggs in the ovaries and the embryos in the brood-pouches are of different sizes and at various stages of development. The biggest eggs are oval and as much as 0·2–0·25 mm. long. The biggest of the brood-pouches contains 13 embryos. Seven are without trace of skeletal plates or ciliated bands; they are spherical or irregularly oval, 0·21–0·29 mm. Six are oval embryos with the beginnings of skeletal plates within them. One is smaller than the others, 0·34 mm. long, and with no ciliated bands. There are about 14 small stem-plates and a very large terminal plate, and there are five orals and five basals but no infrabasals. Three other embryos in good condition are slightly bigger, 0·37–0·40 mm. long and 0·29–0·36 mm. wide, and possess ciliated bands. They have about 18 stem-plates. In two of them there are two very small infrabasal plates—I cannot see a third in either of them or any infrabasal plates in the third embryo. The three posterior bands of cilia are hoop-like and clear, but the first and second bands are difficult to follow; the former seems to surround a depression, the apical pit, and the latter to coalesce with it for a portion of its course.

Kempometra n.g.

Diagnosis. A genus of Zenometrinae including species of small size; P_1 and P_a are absent; the centrodorsal is rounded conical, not higher than broad at the base, its surface showing no differentiation into radial areas; cirrus sockets in 15 closely crowded columns; cirri with few, up to 16, segments all of which but for the first two and the penultimate are longer than broad; no dorsal spines; opposing spine usually absent, if present more or less vestigial; brachials and pinnulars have everted and spinous ends; viviparous.

Kempometra grisea n.sp. (Plate IV, fig. 4)

St. 1957. 3. ii. 37. 7 miles east of Cape Bowles, Clarence Island, South Shetlands. 830 m. Gear DRR. Bottom: rough, stony. Two specimens, both females.

Description. One of the specimens is almost complete with arms nearly 40 mm. long, of more than 60 brachials; in the other all but one of the arms are broken.

The centrodorsal is a cone nearly as high as broad with its ventral edge produced into low corners interradially. The cirrus sockets are arranged in fifteen closely crowded columns, three or four to a column, the sockets of one column alternating in position with those of the next. The sockets are considerably longer than wide.

Cirri *ca.* L; 9–16, usually 14, up to 9 mm. long. The apical cirri are considerably smaller than the peripheral; they may be only half as long and they are usually of 9–12 segments. The description which follows is of the longer cirri (Fig. 9 *a*). The first two segments are wider than long though the second is longer than the first. The third is about one-and-a-half times as long as broad; the fourth to the sixth are more than twice as long as broad. The segments beyond the sixth gradually decrease in length, though all, except the penultimate, which is about as broad as long, are longer than broad. They are slightly wider than the first six segments and each is a little wider distally than proximally, but there is no trace of a dorsal spine. The whole cirrus is laterally compressed, more strongly in the distal than in the proximal half. The opposing spine is usually absent but may be represented by a minute terminal tubercle. The terminal claw is small and hyaline. The texture of the cirrals as of the brachials is very finely thorny.

The radials are fairly long and wider distally than proximally; the length is less than one-third the greatest width (Fig. 9 *b*). The costals are widely separated from one another for the whole of their length. They are deeply incised by the posterior projection of the axillaries; whereas the lateral edges are more than half as long as the greatest width, the length in the mid-line is only about one-tenth of the width. The axillaries are longer than broad and form shoulder-like projections with the costals; the two proximal sides are slightly, the two distal sides strongly, concave. The shapes of these ossicles and of the lower brachials are shown in Fig. 9 *b*. The long second brachials incise the first and form slight shoulders with them.

Syzygies occur between brachials 3 + 4, 9 + 10 or exceptionally 8 + 9, 13 + 14 or 14 + 15, and thereafter at intervals of two to four, usually three, muscular articulations.

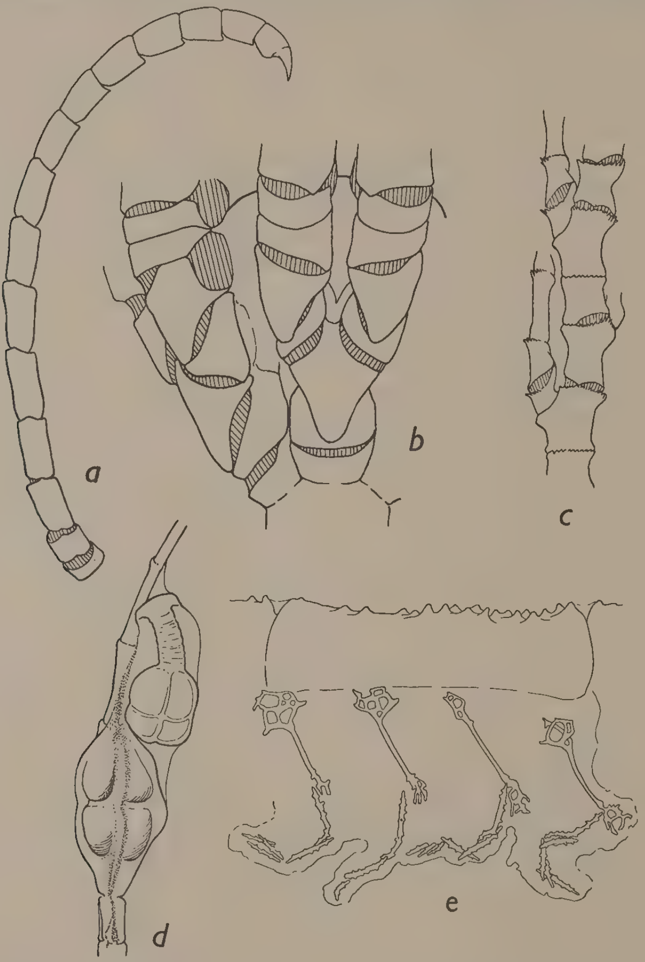

Fig. 9. *Kempometra grisea*. *a*, cirrus. *b*, proximal parts of two rays. *c*, forty-third to forty-seventh brachials. *d*, P_3 from the under side showing the ovary containing large eggs and the brood-pouch containing a pentacrinoid larva. *e*, side-plates and spicules of distal pinnules. *a–b*, ×13. *c–d*, ×15. *e*, ×80.

The two brachials following the first syzygial pair are rectangular, about twice as broad as long. Those for some distance beyond are somewhat wedge-shaped and about as long as broad. The distal brachials are elongated and slender, rectangular, with the articulations, muscular and syzygial, slightly swollen (Fig. 9 *c*). The distal edges of the brachials are everted and produced into frills of tooth-like spines; their entire surfaces, as well as those of the ossicles of the division series, are very finely thorny.

There are no oral pinnules: P_1 and P_a are absent from all arms of both specimens. The first pinnule is P_2, which arises from the outer side of the fifth brachial and carries a gonad. There are two, three, or more usually four, genital pinnules on each side of the arm. The gonad on the outermost genital pinnule, and more rarely that on P_2, may be small. None but the smaller outer genital pinnule has an ambulacral furrow; the course that the furrow would follow, if present, on the other genital pinnules is shown by a double line of pigment. P_2 is of 8 segments, about 4 mm. long. The first segment is slightly longer than broad; the second is about one-and-a-half times as long as broad. The remaining segments are long. The third and fourth are about four times as long as broad. The distal segments (but for the terminal, which is shorter and pointed) are as long but more slender. The other genital pinnules are similar but of more segments and slightly longer: P_3 is of 9 segments, more than 4 mm. long (Fig. 9 *d*); P_4 is of 9 segments and 5 mm. long.

The distal pinnules are of about 15 segments and 7 mm. long. The first segment is broader than long, the second about as long as broad; the articulation between them is greatly widened. The other segments are about four times as long as broad, becoming slightly longer and more slender distally; the articulations are swollen and the distal ends of the segments are everted and spinous.

The species is brood-protecting: on each genital pinnule there is a brood-pouch as well as an ovary. It does not lie alongside the ovary as in some other brood-protecting species, but somewhat to the side of and distal to it. The ovary lies on the third and fourth segments of the genital pinnule and, in dorsal view, projects farther on the side away from the arm from which the pinnule springs than on the other. The brood-pouch lies along part of the fourth, along the fifth and a part of the sixth, segments and projects more on the side towards the arm from which the pinnule springs than on the other (Fig. 9 *d*). On some pinnules the brood-pouch is empty. Two in which it is not have been cleared and mounted. In each there are two or three small eggs, 0·10 mm. in diameter, in the proximal corner of the ovary. In one the remainder of the ovary appears to be occupied by one enormous egg. In the other there are five large eggs of an irregular oval shape, two about 0·25 mm. long, the other three much larger, the largest 0·62 mm. long by 0·36 mm. broad. The brood-pouch of the first contains one large egg with no trace of skeletal plates to be seen within it; in the other there are two, the largest of which is 0·67 mm. long by 0·51 mm. broad.

A third genital pinnule which was examined, a P_3, shows how far this species protects its brood (Fig. 9 *d*). The ovary contains a small number of large eggs like those already described, and perhaps some small eggs; in the brood-pouch is one young pentacrinoid larva, *ca.* 1·3 mm. long, its crown consisting of two closed circles of plates, the basals and orals, in contact with one another, its stalk of ten or more stout joints and a large terminal plate. It lies with its crown against the ovary, the end of its stalk against the sixth segment of the pinnule. Whether this stage represents the farthest to which the pentacrinoid larvae develop before being released from the brood-pouch cannot be said. None is attached to any part of either specimen.

So far as can be seen the disk is not plated. The anal cone is very high, higher than the level of the second syzygy.

The sacculi of the distal pinnules are regularly arranged.

There are three or four side-plates to a segment (Fig. 9 *e*). Each is a long straight rod arising from a branching or reticulate base, with an end which is thorny or slightly branched, or expanded into a small reticulate plate, smaller than that at the base; the plates of the proximal segments are more simple, those of the distal more complex. Continuous with the end of each plate is a row of knobbed and curved rods, the end of one overlapping that of the next, arranged in an arc which travels backwards (towards the base of the pinnule) and inwards; they appear to lie along the edge of the marginal lappets. I see no spicules in the tentacles.

The colour in life was described as: "Dark grey markings on a white ground. General effect grey." It remains so in spirit. The dorsal surfaces of the radials, the ossicles of the division series and the brachials are dusky grey, though the proximal edges of the brachials may, like the muscular articulations, be white. The pinnulars, especially the lower pinnulars of the distal pinnules, are of a darker colour than the brachials; the slightly swollen articulations are white. The cirri appear white in comparison with the rest of the animal; a few of the basal segments, the penultimate segment and one or two of those preceding it may be of a dusky tinge; the terminal claw is hyaline. The disk is yellowish; the anal cone and the ambulacra of the disk, arms and pinnules, are darkly pigmented.

Subfamily *BATHYMETRINAE*

Genus **Phrixometra** A. H. Clark

Phrixometra longipinna (P. H. Carpenter) var. **antarctica** n.var.

(Plate IV, figs. 5 and 6)

St. 156. 20. i. 27. Off South Georgia. 53° 51′ S, 36° 21′ 30″ W. 200–236 m. Gear DLH. Bottom: rock. One specimen.

St. 1948. 4. i. 37. East of Clarence Island. 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. Four specimens.

The specimens from two localities that I describe here as belonging to one new variety differ in some ways from one another. I have thought it better to describe the specimens from each station separately rather than to draw up one description wide enough to cover them all. A partial re-description of *P. longipinna* follows the description of the variety.

Description. The specimen from St. 156 is a rather broken female. None of the arms is complete; the longest is of 35 brachials and 20 mm. long; it seems probable that the arms were 25–30 mm. long in life. Most of the cirri are retained but many are incomplete.

The centrodorsal is a rounded cone with a rather large and rough dorsal pole. The cirrus sockets are closely crowded; they are arranged in indistinct columns, not nearly so regular as those of *P. longipinna* (see below, p. 169). The ventral edge of the centrodorsal is produced into corners interradially.

Cirri *ca.* XLV, 17–19 (Fig. 10 *a*). The first segment is very short, the second as long as broad. The third segment is nearly twice as long as broad, a little constricted in the middle, and considerably wider distally than proximally. The fourth, fifth and sixth are the longest segments, twice to two-and-a-half times as long as broad. They are slightly constricted in the middle and have expanded distal ends. The seventh and eighth segments are twice as long as broad and considerably wider distally than proximally. They and the remaining segments are laterally compressed. The ninth to the twelfth are of roughly equal length, but each is a little wider distally than the one before it. All the distal segments are a little longer than broad. The distal part of the cirrus is considerably wider than the median part. The opposing spine is strong; it stands out at right angles to the penultimate segment, its inner edge straight, its outer convex. The terminal claw is strong and curved.

The radial is very short (Fig. 10 *b*). The costal is much longer; it is narrower distally than proximally and it is deeply incised by the posterior projection of the axillary which makes a projection with it. The costals are not in lateral contact. The axillary is about as long as broad; the proximal edges are straight, the distal deeply concave.

Syzygies are very numerous. The first is between the third and fourth, the second between the ninth and tenth, the third between the fourteenth and fifteenth brachials. There are the following exceptions: on one arm the first, on another the second syzygy, is between the eighth and ninth brachials; on another arm the third syzygy is between the twelfth and thirteenth brachials.

The first brachials are short, their inner edges shorter than the outer and not in apposition. They are strongly incised by the second brachials which are slightly longer than broad, roughly triangular with the inner and distal edges concave, the outer convex. The interior edge of the first syzygial pair is longer than the exterior and greater than the width of the ossicles. The brachials between the first and the second syzygy, the fifth to eighth, are roughly rectangular in shape; the fifth is slightly broader than long or is square while the others are slightly longer than broad. Those between the second and third syzygies are longer on one side than the other and a little longer than broad. The distal brachials are more elongate and rectangular (Fig. 10 *c*).

The radials, primibrachs and first four brachials are smooth. The distal edges of the following brachials are slightly raised and are produced into spines which are small in the lower part of the arm but larger and conspicuous on the outer brachials.

In all the pinnules the first two segments are short; the others are longer than broad or elongated, with their distal edges strongly flared and spiny so that the joints have a swollen appearance. The oral pinnules are the longest, nearly twice as long as the first genitals and about one and one-third times as long as the outer pinnules (Fig. 10 *d*). P_1 is not complete on any arm. P_a, P_2 and P_b are of 18–19 segments, 8 mm. long. P_3, the first genital, is of *ca.* 10 segments and about 4 mm. long (Fig. 10 *e*); P_5 resembles it but has a larger gonad. P_6 is of 14 segments about 6 mm. long, and P_9, the last genital

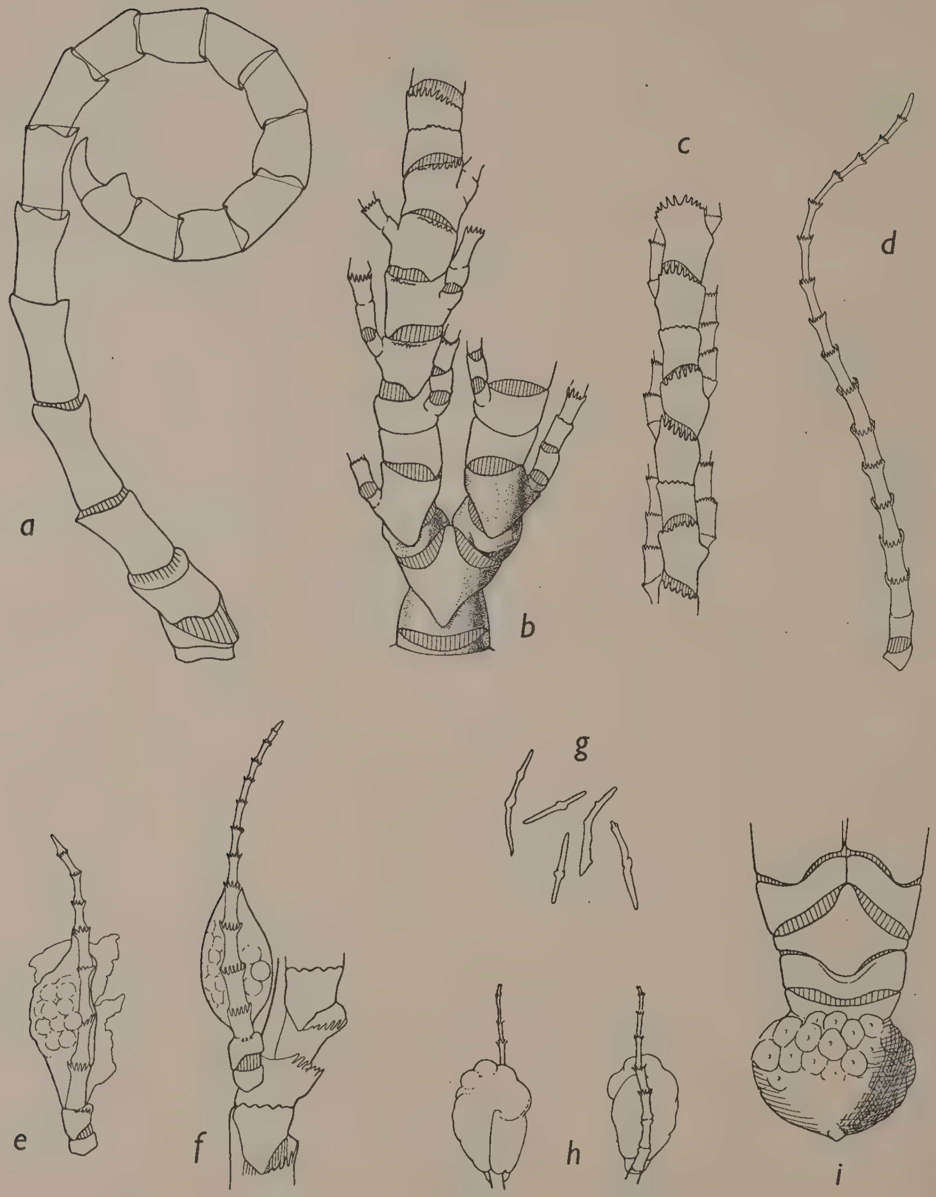

Fig. 10. *Phrixometra longipinna* var. *antarctica*. *a*, cirrus. *b*, proximal part of a ray. *c*, twenty-eighth to thirty-fourth brachials. *d*, P_a. *e*, P_3 from the left arm of a ray with an ovary on the left, a broken and empty brood-pouch on the right. *f*, P_6 from the left arm of a ray; most of the embryos have been lost from the brood-pouch on the right. *g*, spicules from the tentacles. *h*, P_d from right arm of a ray, on left from below, on right from above. *i*, centrodorsal and proximal part of ray. *a*, ×25. *b–f*, *h–i*, ×13. *g*, ×260. (*a–g* from specimen from St. 156; *h–i*, from specimens from St. 1948.)

pinnule, is of 17 segments, 6 mm. long. The ambulacral furrow is absent from the lower genital pinnules but present on the outer. The distal pinnules are of about the same number of segments and length as the last genital, P_9.

The elongated segments of the oral pinnules are up to three times as long as broad; those of the lower genital pinnules may be a little more elongated; those of the outermost pinnules are shorter, up to about twice as long as broad.

The disk cannot be seen.

Sacculi are fairly conspicuous, more numerous and more regularly arranged on the outer than on the genital pinnules. There are no side- or cover-plates along the pinnule ambulacra. Some of the tentacles have within them numbers of rod-like spicules (Fig. 10 *g*).

The specimen is of a pale straw colour in spirit except for the syzygial pairs which are dusky and stand out as dark bands along the arms.

This new variety, like the parent species (see below), is brood-protecting: the embryos undergo their development in pouches alongside the ovaries. The pouches are always on the aboral side of the pinnule, nearest the arm and the outside. The ovaries and brood-pouches of the middle genital pinnules lie along the third to fifth segments. Both can be seen at the same time from the outside and their walls are so thin that their contents can be seen through them (Fig. 10 *e*, *f*). The ambulacral furrow of the outer genital pinnules lies along the dividing line on the ventral side. I have not been able to see the pore which must exist in the septum dividing ovary and brood-pouch. The wall of each pouch is split open for the whole of its length exposing the embryos within. There are ten or eleven in each pouch; they occur in one layer and each is lightly attached to the floor of the chamber, the dividing septum, by an extremely thin membrane. They are roughly spherical, except that one end is strongly flattened to form the suctorial disk, from 0·21 to 0·24 mm. in diameter, considerably smaller than those of *Eumorphometra concinna*, and all appear to be at the same stage of development. The vestibulum is clearly marked. There are four bands of cilia, one lying around the edge of the suctorial disk; I cannot see traces of a more anterior band. The skeleton consists of about 18 stem-joints and a larger terminal plate and of ten large but openly branching plates, five orals and five basals, which may be nearly in contact with one another.

The single female from St. 1948 is very much smaller than that from St. 156 and its arms are even less complete; one of the longest is of 21 brachials and 10 mm. long.

The centrodorsal is a moderately low and slightly rounded cone. The dorsal pole is large, bare and rounded. The arrangement of the closely crowded cirrus sockets appears to be in part in columns and in part in alternating rows.

Cirri L, 12–17. The apical have the smaller number of segments and are considerably shorter than the peripheral. The cirri closely resemble those of the specimen from St. 156 except that they are smaller and that the opposing spine is much smaller or it is obsolete.

The radials, primibrachs and brachials resemble those of the specimen from St. 156.

The distal edges of the costals are everted. The distal edges of the lower brachials are more strongly everted and spiny than in the other specimen.

The pinnules are generally similar to those of the specimen from St. 156, but there are differences: there is only one oral pinnule, for P_2 carries an ovary and brood-pouch; the segments of the pinnules, particularly of the orals, are less elongated. Nevertheless P_1 is about twice as long as the first genital, P_2. The segments of the pinnules have expanded and spiny distal ends. P_6 is the lowest pinnule to have an ambulacral furrow.

P_1 is of 18 segments, about 5 mm. long. The third and succeeding segments are a little more than twice as long as broad. P_2 is of 8 segments, 2·5–3 mm. long. The first segment is slightly longer than broad, the second nearly twice as long as broad. The remaining segments are nearly four times as long as broad. The gonad lies along the third to fifth segments. No complete P_3 can be seen. P_4 is of 10 segments, 3·5 mm. long, and is similar to P_2 except that the ovary and brood-pouch lie along the third to sixth segments. P_6 is the last genital pinnule. It is of more than 12 segments and more than 4 mm. long. It carries a very small ovary and brood-pouch on the third and fourth segments. The earlier of the distal pinnules are of 14 segments and more than 4 mm. long.

Sacculi are numerous and conspicuous.

There are rod-like side- or cover-plates with perforated or branched ends along some of the pinnule ambulacra, and some of the tentacles contain large numbers of smooth and knobbed rod-like spicules.

The first four or five segments of the cirri are yellow; the remainder are of a dusky hue. The rest of the specimen is overlaid with a light yellow tinge.

An enormous brood-pouch lies alongside each ovary and runs farther than it distally. The large numbers of embryos that the brood-pouches contain may clearly be seen through their thin walls; the walls of many are ruptured. The ovary lies a little to the adoral side of the pinnule. The brood-pouch lies on the aboral side, nearest the arm and the outside, but distally it passes also across the ventral side of the ovary and may extend farther adorally than the ovary, so that it is crescent- or comma-shaped. The embryos in the brood-pouch are in various stages of development, but the most highly developed are always in the distal part; if any part of the brood-pouch is ruptured it is this; which makes it appear that the ruptures may be natural, freeing the fully formed larvae. The relationships of the ovary and brood-pouch are shown in Fig. 10 *h*.

There are about seventeen embryos in a large brood-pouch. They lie not in a single layer, and are not all at the same stage of development, as in the specimen from St. 156 and in *Phrixometra longipinna*: they are arranged in an irregular double layer and are in various stages of development, the most highly developed being at the distal end (see above). Presumably the eggs pass from the ovary into the brood-pouch at the proximal end. The fully formed larvae are similar to those of the specimen from St. 156, but they are considerably bigger, 0·30–0·36 mm. long.

I have no doubt that the three very broken males from this station are of the same species. They do however differ from the female in some ways. They are larger and the ossicles of the division series and the lower brachials are more massive and conspicuously wider than in the female (Fig. 10 *i*). The cirri are longer. These may perhaps be signs of greater age.

In two specimens P_3 is the first genital, in the other P_2. The following are the numbers of segments and the lengths of some pinnules:

First specimen:	P_1	20 segments	5 mm.
Second specimen:	P_2, the first genital pinnule	12 segments	4 mm.
Third specimen:	P_1	19 segments	6 mm.
	P_a	16 segments	5 mm.
	P_3, first genital pinnule—none complete; but		
	P_c	11 segments	3·5 mm.

The testes are long fusiform bodies, the biggest lying along the third to eighth segments of the genital pinnules.

The disk is naked, the anal cone very high.

Phrixometra longipinna (P. H. Carpenter)

Antedon longipinna Carpenter, 1888, p. 185, pl. xxx, figs. 1–3.
Phrixometra longipinna A. H. Clark, 1917, p. 131.

Carpenter described this species from "three mutilated individuals" taken by the 'Challenger' from 600 fathoms off the River Plate. It has not been recorded since. I have re-examined the type specimens.

The centrodorsal is a straight-sided or rounded cone with a greater diameter than height. The cirrus sockets are in fifteen regular or slightly irregular columns. Carpenter describes the cirri as being about 30 in number, of 20–25 segments. Only two cirri are now left, one incomplete of 20 segments, one complete of 19. They differ from those of the var. *antarctica*, as Carpenter's fig. 3, which is a good picture, shows. The longest segments are only just more than twice as long as broad. The distal segments are not strongly compressed: they are not broader than the more elongated middle segments, so that the end of the cirrus does not appear heavier than the middle.

The ossicles of the division series and the brachials are very like those of the var. *antarctica*, as a comparison of Carpenter's figures and mine will show. The distal edges of the outer brachials are strongly thorny.

Carpenter's description of the pinnules is misleading. He states that those following the first two pairs are "all long, decreasing but slowly in size", whereas the most conspicuous feature of the pinnules is, as in the var. *antarctica*, a sharp contrast in the number of the segments and the lengths between the orals and the genitals.[1] The contrast is far stronger than in either of the specimens of the var. *antarctica*: the oral pinnules reach much farther along the arms. Their elongated segments, beyond the third, are four to six times as long as broad.

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[1] Clark (*loc. cit.*) in his diagnosis of *Phrixometra* repeats the error in other terms, saying that the pinnules following the orals are similar to them.

The oral pinnules were of 18 elongated segments and about 7 mm. long, but not one of them is now complete. The following are the numbers of segments remaining in, and the lengths of some of, the oral pinnules. In one specimen P_a is of 13 segments, 6·5 mm. long; in a smaller specimen P_1 is of 12 segments and 5 mm. long; and P_a and P_2 are of 12 segments, 6 mm. long. Some of the earlier genital pinnules are complete and are as follows: P_3 of about 9 segments, 4 mm.; P_4 similar in the same specimen, of 10 segments and about 3 mm. long in another. The ambulacral furrow first appears on P_5. The distal pinnules are of about 18 segments and about 6·5 mm. long.

One of the specimens is a female. What Carpenter described as its "much swollen ovarian sacs" are brood-pouches similar to those of the first specimen (from St. 156) of var. *antarctica*. They lie alongside the ovaries on the third to fifth segments of the genital pinnules. Each is split open for the whole of its length exposing the embryos within. There may be up to 30, arranged in a single layer. They are irregularly spherical, 0·18–0·24 mm. in diameter. They appear to be at the same and at an early state of development, having no skeletal plates within them and no bands of cilia around them.

There is no doubt that the specimens I have described above as the var. *antarctica* are nearly related to *P. longipinna*. They are distinguished from it by the smaller number of segments in the cirri and by the proportions of those segments; by not having the cirrus sockets arranged in such definite columns; and by the less elongated segments of the oral pinnules.

But the specimens of the var. *antarctica* from the two localities differ from one another. The number of cirrus segments is smaller in those from St. 1948 than in that from South Georgia. In the South Georgia specimen P_3 is the first genital pinnule as it is in two of the males from St. 1948; in the other male and in the female it is P_2. The elongated segments of the oral pinnules are more elongated in the South Georgia specimen than in those from St. 1948, though less so than in *P. longipinna*. The shapes of the brood-pouches and the arrangement of the embryos in them differ in the two females; the brood-pouch of the South Georgia specimen resembles that of the parent species.

It was long before I could decide how to treat the specimens. I hope this may be the best way.

Phrixometra nutrix (Mortensen) (Plate IV, fig. 7)

Thaumatometra nutrix Mortensen, 1918, pp. 15–18, figs. 14–15, pl. v. 1920, pp. 56–8, fig. 8, pl. xxviii.

St. 175. 2. iii. 27. Bransfield Strait, South Shetlands. 63° 17′ 20″ S, 59° 48′ 15″ W. 200 m. Gear DLH. Bottom: mud, stones and gravel. One specimen.

Description. Mortensen described this species from one poorly preserved female, lacking any fully developed cirri, from the Burdwood Bank. The present specimen is a male from the Bransfield Strait with most of its cirri present, fully developed and complete. In other ways it is imperfect. No arm is complete: some are broken off at the first syzygy, others at the second or third; two are regenerated, one from the second the other from the third syzygy, and are about 13 mm. in length. Most of the arms complete to the second syzygy are broken but not detached at the first. It is a fragile species.

The centrodorsal is low and rounded. The dorsal pole is rather large, rounded and a little rough. The cirrus sockets are closely set, indistinctly arranged in columns.

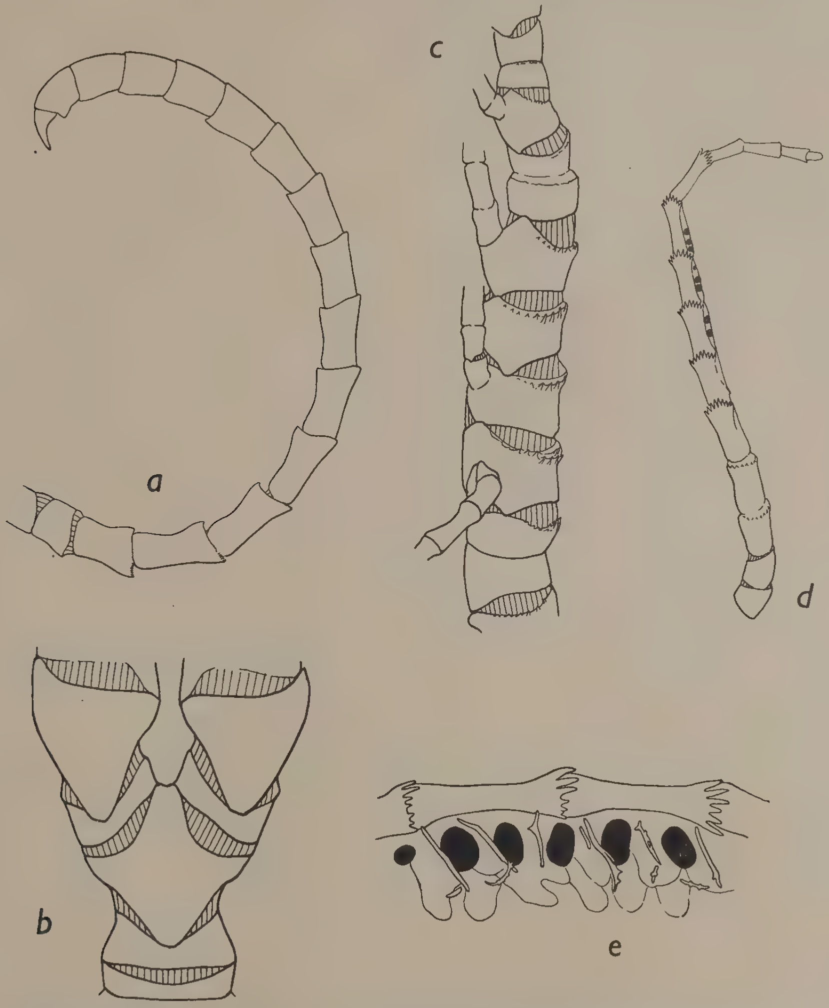

Fig. 11. *Phrixometra nutrix*. *a*, cirrus, ×27. *b*, proximal part of a ray, ×33. *c*, third to thirteenth brachials seen obliquely from the side, ×20. *d*, P_1, ×20. *e*, ambulacral skeleton of distal pinnule, ×55.

Cirri *ca*. XLVII, 12–18. The first two segments are very short, the first shorter than the second; the remainder are longer than broad, the distal only slightly so (Fig. 11 *a*). The third to the sixth or eighth are the longest; they are slightly constricted in the middle, more strongly on the dorsal than the ventral side. The segments beyond are wider at the distal than the proximal ends but no dorsal spines are developed. The distal segments are noticeably wider than the middle segments. The terminal claw is strong but the opposing spine, which is directed obliquely forwards, is weak. A few developing cirri of the kind described and figured by Mortensen are present.

The shapes of the radials and axillaries are as Mortensen describes them, but the costals are more conspicuously narrower distally than proximally, and more deeply incised by the axillaries, than he shows (Fig. 11 *b*). The shapes of the lower and of the distal brachials are shown in Fig. 11 *c*; the latter are elongated. The distal edges of the brachials beyond the first syzygy are raised and produced into short but stout spines.

The first two segments of all the pinnules are short; the remainder are elongated with their distal edges flared out and produced into thorns. P_1 is of 14 segments, about 5 mm. long (Fig. 11 *d*). P_2 is a genital pinnule. On no arm does it consist of more than 9 segments or is it more than 4 mm. long, but on none is it complete; it seems probable that it was originally of 14 segments like P_1 as Mortensen describes it. The large fusiform gonad begins on the third and lies along the fourth, fifth and sixth segments. P_3 is of 10 segments, 4–5 mm. P_5, of 11 segments and 4–5 mm. long, is the first to have an ambulacral furrow.

There are no gonads on the pinnules of the regenerated parts of the only two arms which are nearly complete. The outer pinnules of these arms are of about twelve segments.

The disk is naked, the anal cone very high.

Sacculi conspicuous, irregularly arranged on the lower part of the arms and the genital pinnules, regularly arranged on the outer pinnules.

In Mortensen's specimen there were no side- or cover-plates. Along the middle segments of the outer pinnules of this Discovery specimen there are side- and cover-plates, three pairs to each segment, but they are so reduced as to be simple and rod-like (Fig. 11 *e*).

The shapes of the ossicles of the division series and of the brachials and, above all, of the cirri, of this species and the next and of *P. longipinna* var. *antarctica* are so alike that I think they ought to be placed in the same genus. For that reason I have removed Mortensen's species, *nutrix*, from *Thaumatometra* to *Phrixometra*, and placed my new species in the same genus.

Phrixometra rayneri n.sp. (Plate IV, fig. 8)

St. 160. 7. ii. 27. Near Shag Rocks. 53° 43′ 40″ S, 40° 57′ W. 177 m. Gear DLH. Bottom: grey mud, stones and rock. One specimen.

DESCRIPTION. This is a small fragile species, and in the single specimen, which is a male, some of the pinnules are damaged and most of the arms are broken. Two of the arms are nearly complete and are about 20 mm. long.

The centrodorsal is small, low and rounded; the dorsal pole is rather large and rough. The ventral edge of the centrodorsal is produced into low corners interradially.

The cirrus sockets are closely set in two rows around the periphery, the sockets of one row in line with those of the other, i.e. they are arranged in columns of two.

Cirri *ca.* XXX, 14–17. The cirri of the ventral row are a little longer, *ca.* 6 mm., and usually of one or two more segments than those of the dorsal row, *ca.* 5 mm. The first segment is very short, the second about as long as broad; the remainder are longer than broad, the distal only slightly so (Fig. 12 *a*). The third to the fifth are the longest; they are slightly constricted in the middle, a little more strongly on the dorsal than the ventral side. The distal edge of the second to the fourth or fifth segment is produced into a strong thorny flare around the base of the next; the outer segments have their distal edges flared only on the dorsal side, and to a less extent and the flare is not thorny. There are no dorsal spines. The segments beyond the sixth or seventh are wider distally than at the base and they are conspicuously wider and heavier than the proximal segments. The terminal claw is short. The opposing spine is at right angles to the penultimate segment; its short distal edge is convex, its longer proximal edge concave. The cirri are very similar in general appearance to those of *P. nutrix*.

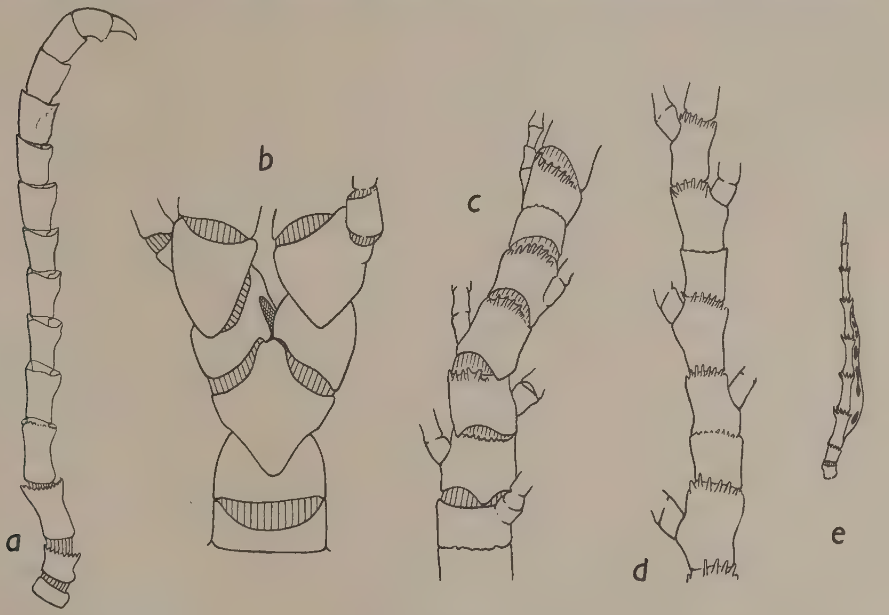

Fig. 12. *Phrixometra rayneri*. *a*, cirrus, ×20. *b*, proximal part of ray, ×27. *c*, fourth to tenth brachials, ×27. *d*, distal brachials, ×20. *e*, P_5, ×13.

The radials, having concave distal edges, are fairly short in the mid-line but long interradially (Fig. 12 *b*). The costals are considerably longer than the radials, deeply incised by the axillaries; their lateral edges are rounded, not in apposition. The axillaries are about as long as broad, their distal edges strongly concave; the lateral corners are finely thorny.

The first brachials are deeply incised by the second; their inner edges are much shorter than the outer. The distal edges of all the brachials beyond the first syzygy are raised into a row of strong spines, much longer than those of *Phrixometra nutrix*. The brachials between the first and second syzygies are roughly rectangular, about as long as broad (Fig. 12 *c*); the distal are elongated, roughly oblong (Fig. 12 *d*). Syzygies are numerous, the first between the third and fourth brachials, the second between the ninth and tenth and the third between the fourteenth and fifteenth; beyond the third the syzygial pairs occur at intervals of only one brachial.

In all pinnules the first segment is short, the second as long as or a little longer than broad. The remainder are elongated and somewhat constricted in the middle, the proximal less so than the distal; the distal edge of each is produced into a wide spiny flare around the base of the next, giving the joints a swollen appearance (Fig. 12 *e*). P_1 is of 11 or 12 segments, *ca.* 3 mm. long; P_2 of about 13 or 14 segments, *ca.* 4 mm. long, with no gonad. P_3 is the first genital pinnule; it is shorter than P_2, of about 9 segments, *ca.* 3 mm. long. There are only three pairs of genital pinnules, all resembling P_3. The long yellow gonad lies along the third to sixth segments. P_5 is the first to have an ambulacral furrow. The outer pinnules are of up to 14 or 15 segments, 4–5 mm. long.

The disk cannot be seen. The anal cone appears to be high.

The sacculi are fairly conspicuous, irregularly arranged along the genital pinnules, regularly along the outer.

There are no side- and cover-plates along the ambulacra of the outer pinnules nor any spicules in the tentacles.

The colour in spirit is whitish, the gonads a pale yellow.

I hesitated for a long time before describing this specimen as a species distinct from *nutrix* which it so strongly resembles. The cirri of the two species are similar and so are the pinnules, except that the oral pinnules of this species are more rigid and spiny. The species is altogether more spiny than *nutrix*. P_3 is the first genital pinnule, not P_2 as in *nutrix*.

What makes me describe it as a new species is that it has only 30 cirri whereas Mortensen's female specimen of *nutrix* and my male have 45.

Subfamily *ISOMETRINAE*

Genus **Isometra** A. H. Clark

Clark (1908, p. 133) formed this genus with *Antedon lineata* Carpenter 1888 as genotype and *Isometra angustipinna* (Carpenter) as the only known species. He wrote: "*Isometra angustipinna* is without doubt the young of *Antedon lineata*, Carpenter." Carpenter's species *A. lineata* and *A. angustipinna* were each described from one specimen taken at the same Challenger station off the mouth of the River Plate, the depth being 1097 m. Neither has since been recorded. As thorough an examination as their frail condition would allow has been made of the two specimens. Each is mature and they differ too much from one another to be regarded as of one species. They must therefore be known as *Isometra lineata* and *I. angustipinna*, and brief descriptions of them as such are given below.

Mortensen (1918) described *I. vivipara* from shallow water off the coasts of Uruguaya and northern Argentina, from the Burdwood Bank, and from the eastern side of Graham Land.

In the present collection there are many specimens of *I. vivipara* from near the Falklands and from the Burdwood Bank, and one specimen, differing slightly from them, from the Bransfield Strait. There are small numbers of three new species, all viviparous, one from the Shag Rocks, another from near Clarence Island in the South Shetlands, the third, represented by specimens from Bismarck Strait, to the west of Graham Land, from the Bransfield Strait and from the Ross Sea on the other side of the continent. Two of the new species are very close to *I. vivipara*.

The genus appears to be a well-marked natural assemblage.

Isometra lineata (Carpenter)

Antedon lineata Carpenter, 1888, p. 183, pl. xiii, figs. 4, 5.
Isometra angustipinna (part), Clark, 1908, pp. 133–4.

The single specimen is much larger than that of *I. angustipinna*: Carpenter gives its spread as "probably about 18 cm."

The most complete of the remaining cirri is detached and probably lacks one or two basal segments. It is of 30 segments. Stumps of other cirri remain on the centrodorsal so that an almost complete description of a cirrus is possible. The first two segments are short; the third is longer, but broader than long. The fourth to about the tenth are longer than broad, decreasing in length towards the tenth. The remainder are broader than long and the more distal have a strong and characteristic dorsal spine the point of which is sub-terminal; it is well shown in Carpenter's figure. The spine is reduced on the two or three segments before the penultimate. The ventral edge of the cirrus is smooth. The opposing spine is strong and triangular; the terminal claw is large and strongly bent.

The shapes of the primibrachs and lower brachials are shown in Fig. 13 *a*; they have sharp and nearly straight side-edges as in the other species of *Isometra*. The syzygial pairs beyond the third are separated by one to four, usually two or three, brachials.

P_1 is of about 9 long slender segments and is *ca.* 5 mm. long; the first three segments are attached by a web of tissue to the disc. P_2 and P_3 are shorter, about 3·5 mm., of 8–9 segments; the first two segments of P_2 are attached by a web of tissue to the arm. The first genital pinnule is so far out as P_6 or P_7; they are of about 9 segments and *ca.* 5 mm. long. The third and fourth segments of the genital pinnules are slightly and almost symmetrically expanded (Fig. 13 *b*); they are considerably longer than broad. The specimen is a male.

The distal pinnules have side- and cover-plates, two or three pairs to each segment, along the ambulacra. The drawing (Fig. 13 *c*) is of the single preparation made; in it the cover-plates are displaced, being pushed back so as to overlap the side-plates. The latter are rods with branching and reticulate ends. The cover-plates are of a beautiful bush-shaped form: the narrow base—the root-like part—is connected with wide-spreading fan-like branches by a short stem which is always narrow and usually not perforated. Some of the tentacles contain knobbed spicules.

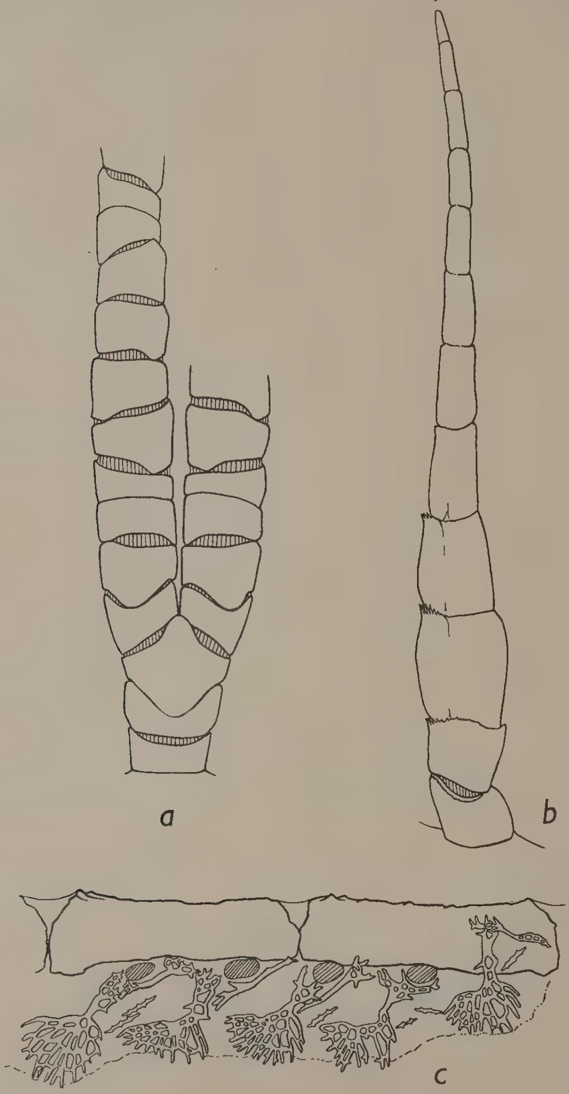

Fig. 13. *Isometra lineata*. *a*, proximal part of a ray, ×8. *b*, a genital pinnule, P_{11}, ×16. *c*, side- and cover-plates of a distal pinnule, ×66.

Isometra angustipinna (Carpenter)

Antedon angustipinna Carpenter, 1888, p. 189, pl. xxix, figs. 1–4.
Isometra angustipinna (part) Clark, 1908, p. 133.

The single specimen is small: Carpenter gives its spread as probably 5 cm.

Only one cirrus remains attached to the centrodorsal, an upturned cirrus of 27 segments but of an immature appearance. There is one small, detached, cirrus of 22 segments which is complete and mature. The first two segments are short, the third is longer than broad and flared at the end. The fourth to about the eighth are longer than broad, but decreasing in length; their ends are flared, more strongly on the dorsal than the ventral side but sufficiently on the ventral side to make that edge of the lower part of the cirrus uneven. The other segments are shorter, about as long as broad, with no dorsal spine but a faint keel which becomes obsolete on one or two segments before the opposing spine. The opposing spine is strong, the terminal claw strongly curved.

The shapes of the primibranchs and lower brachials are shown in Fig. 14 *a*; they have sharp, straight side-edges. The syzygial pairs beyond the third are separated by only one brachial.

P_1 is very short, about 2 mm., of five or six segments of which all, or nearly all, are attached to the disk by a web of tissue. On some of the arms P_2 is of the same length as P_1 and of about six segments, but on most it is a genital pinnule about 5 mm. long. The third and fourth segments of the genital pinnules are more strongly and less symmetrically expanded than those of *I. lineata*. They are longer than broad and more strongly expanded on the distal than the proximal side (Fig. 14 *b*). The gonads are fully developed and appear to be testes.

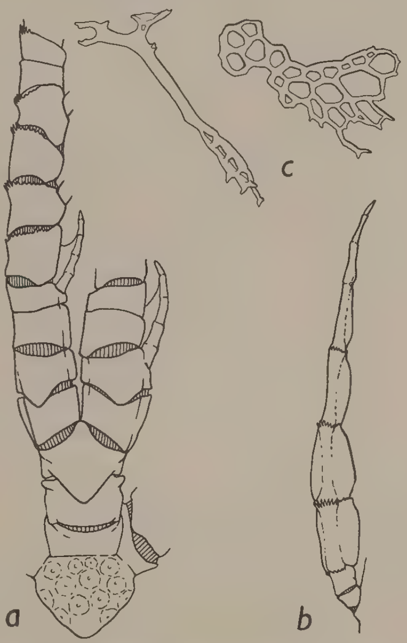

Fig. 14. *Isometra angustipinna*. *a*, centrodorsal and proximal part of a ray, ×8. *b*, P_4, a genital pinnule, ×12. *c*, a side- and a cover-plate from a distal pinnule, ×150.

The arms are broken off shorter, and the pinnules which remain are in a much poorer state of preservation, than those of *I. lineata*, so that, although an ambulacral skeleton can be seen, it is difficult to be sure of its nature. There appear to be two sets of plates, side- and cover-plates, one or two pairs on either side of each segment. One of each is shown in Fig. 14 *c*; the "side-plate" is rod-like with a root-like base; the "cover-plate" with its fan-like distal portion, resembles the plates of *I. lineata*. No spicules can be seen in the tentacles.

There are good reasons for regarding this specimen as a different species to *I. lineata* and not as the young of it. Although it is so much smaller, its gonads are mature. P_2 is the first genital pinnule, not P_6 or P_7 as in *lineata*. The cirri are quite different, as Carpenter's figures show.

Carpenter describes the arms of both as smooth. This is more true of *lineata* than *angustipinna*. In the latter the distal edges of all brachials beyond the first four or five are raised and produced into spines; in the former the distal edges of the brachials are not everted and only those beyond the second syzygy have spines: the lower brachials are quite smooth.

Isometra vivipara Mortensen (Plate V, figs. 1 and 2)

Isometra vivipara Mortensen, 1918, pp. 10–15, figs. 6–13, pl. i, figs. 6–10, pl. ii, figs. 5–7. 1920, pp. 31–48, pls. xiv–xxiii. Clark, 1923, p. 42.
Antedon hirsuta Andersson, 1904, pp. 1–7, Taf. i–ii.

St. 175. 2. iii. 27. Bransfield Strait, South Shetlands. 63° 17′ 20″ S, 59° 48′ 15″ W. 200 m. Gear DLH. Bottom: mud, stones and gravel. One female.

St. 652. 14. iii. 31. Burdwood Bank. 54° 04′ S, 61° 40′ W. 171–169 m. Gear OTL. Fifteen males and three females; pentacrinoid young.

St. WS 81. 19. iii. 27. 8 miles N 11° W of North Island, West Falkland Island; from 51° 30′ S, 61° 15′ W to 51° 30′ 30″ S, 61° 10′ W. 81–82 m. Gear OTC. Bottom: sand. One male and two young.

St. WS 83. 24. iii. 27. 14 miles S 64° W of George Island, East Falkland Island; from 52° 28′ S, 60° 06′ W to 52° 30′ S, 60° 09′ 30″ W. 137–129 m. Gear N 7–T. Bottom: fine green sand and shells. Twelve large specimens with most or all of the arms broken off; four recognizable as males and six as females.

St. WS 85. 25. iii. 27. 8 miles S 66° E of Lively Island, East Falkland Island; from 52° 09′ S, 58° 14′ W to 52° 08′ S, 58° 09′ W. 79 m. Gear OTC. Bottom: sand and shell. The centro-dorsals, calices, and arm-bases of two specimens, and fragments of arms, both male and female.

St. WS 212. 30. v. 28. 49° 22′ S, 60° 10′ W. 242–249 m. Gear N 7–T. Bottom: green sand, mud and pebbles. One immature specimen.

St. WS 228. 30. vi. 28. 50° 50′ S, 56° 58′ W. 229–236 m. Gear OTC. Bottom: coarse white sand. One female.

St. WS 248. 20. vii. 28. 52° 40′ S, 58° 30′ W. 210–242 m. Gear OTC. Bottom: fine green sand, pebbles and shells. One male and three females.

St. WS 824. 19. i. 32. 52° 29′ 15″ S, 58° 27′ 15″ W. 146–137 m. Gear OTC. Bottom: green speckled sand, and shells. Two incomplete specimens, one a female.

St. WS 877. 4. iv. 32. 52° 35′ 30″ S, 61° 04′ W. 350 (–0) m. Gear NR. Bottom: no data. Seven males and four females; pentacrinoid young.

All but one of these 55 specimens come from nine stations near the Falkland Islands or on the Burdwood Bank, from depths of between 79 and 350 m. These are a few of very many trawling stations made on the Burdwood Bank, around the Falkland Islands, between them and Tierra del Fuego and the American mainland, and on the Patagonian shelf to the north. Some are shown in *Discovery Reports*, Vol. I, Station List, pl. iv and Vol. III, Station List, pl. iii. A later trawling survey of the area has been made, but the Station List including it has not been published. It consists of a larger number of stations, arranged in lines running out from the American coast to the 100 fathom line, and covers a greater area, particularly to the north, the last line being in the latitude of 44° S, than either of the two previous surveys. From it there are specimens of *I. vivipara* from two stations only, the last two in the list above, both of them very near the Falkland Islands. It is strange that it should not have been taken at any of the stations farther from the Falklands, to the west and north and along the Patagonian coast, especially since the depths of many of them fall within the range of those at which the species occurred around the Falkland Islands; and especially since the species is known to occur much farther north, for some of Mortensen's specimens came from the coasts of Uruguaya and northern Argentina.

Some of Mortensen's specimens came, too, from far south, from the east side of Graham Land in the Antarctic. But from the trawl and dredge hauls made by the Discovery vessels along the coasts of the Falkland Dependencies—many at South Georgia, few at the South Sandwich and South Orkney Islands, and many in the Bransfield Strait and on the west side of Graham Land—there is only one specimen of *I. vivipara*. It is from the Bransfield Strait and, although it differs in some ways from those described by Mortensen and from the remainder of the present collection, it is not regarded here as a separate variety or species (see below).

DISTRIBUTION. *I. vivipara* is known from off the coasts of Uruguaya and north Argentina; from around the Falkland Islands and on the Burdwood Bank; and from the Bransfield Strait and the east coast of Graham Land in the Antarctic.

DESCRIPTIVE REMARKS. The 54 specimens from near the Falkland Islands and from the Burdwood Bank agree fairly closely with Mortensen's description. They are up to 70 mm. in arm length. The majority are of a white or pale straw colour in spirit; some have a reddish tinge in parts as, for example, on the proximal cirrals; one is a light brown and two a very pale yellow. In all the first seven or eight cirrals are slightly darker than those beyond, which are white; the change may be sharp or gradual.

The number of cirri and the number of segments of which they are made may be greater than Mortensen gives. Cirri up to LX, 26–43. The first two segments are short, the third is longer. The fourth or the fifth is as long as broad. The fifth to about the tenth may be longer than broad, the first of them appreciably so. The distal segments are wider than long and are produced into dorsal spines which may be low as Mortensen (1918, p. 11, fig. 7) shows but are often stronger; they may be stronger than those shown in Fig. 15 *a*. The opposing spine is erect, the terminal claw short but strong.

The normal positions of the first two syzygies are, as Mortensen says, between the third and fourth and the ninth and tenth brachials but there are many irregularities. In one specimen a first syzygy is between the sixth and seventh brachials. In others where the first syzygy is normally placed the second may occur between any pair of brachials between the fifth and the eleventh. In one specimen there is a chain of syzygies on one arm uniting each of the pairs of brachials from the third and fourth to the eleventh and twelfth, beyond which the sixteenth and seventeenth are the next syzygial pair.

The specimens vary from being entirely smooth to being finely thorny along the distal edges of the outer brachials and very finely so along the distal edges of the pinnulars (Fig. 15 *b*).

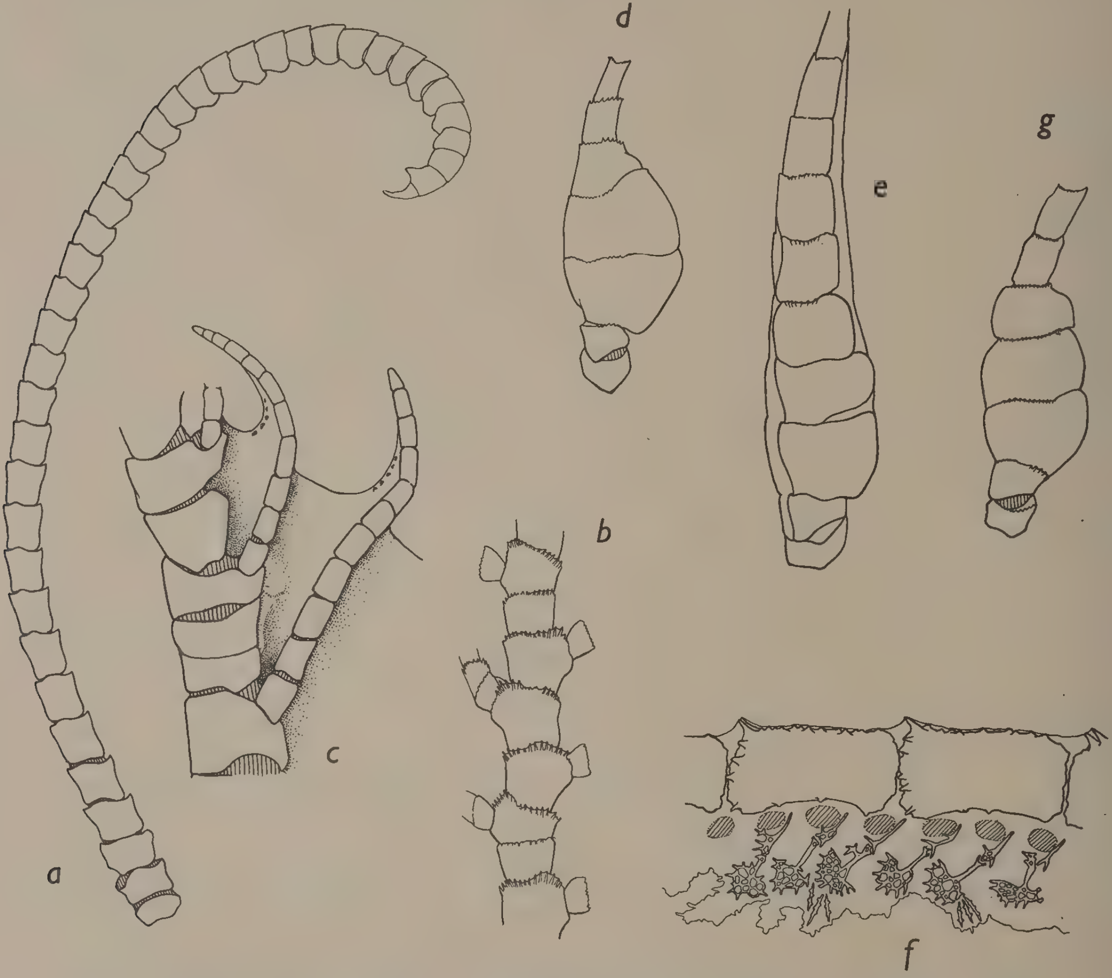

Fig. 15. *Isometra vivipara*. *a*, cirrus. *b*, distal brachials. *c*, proximal part of an arm with P_1 and P_2. *d*, a middle genital pinnule of a female. *e*, a middle genital pinnule of a male. *f*, well developed side- and cover-plates of distal pinnule. *g*, P_7 of the female from the Bransfield Strait. *a* and *c*, ×11; *b*, *d*, *e*, and *g*, ×13. *f*, ×60.

P_1 is always longer and usually stouter than P_2, and P_3 is usually slightly shorter than P_2. P_1 is of 10–17, usually 10–13, segments, and 5–9 mm. long. It is not free proximally, for its first four to six segments are closely attached to the disk, and the next one or two are connected by a web of tissue with the disk (Fig. 15 *c*). It is sometimes much stouter than P_2 with its basal segments strongly compressed so that they are keeled dorsally; it is sometimes only slightly heavier with none of its segments compressed. The basal segments of the other oral pinnules are attached to the arm by a web of tissue. P_2 is of 9–13, usually 10, segments and 5–7 mm. long. P_3 is of 9–14, usually 10–12, segments and 4–7 mm. long.

The first genital pinnule is P_4, P_5 or P_6, usually P_5. The last may be so far out as P_{26}, or perhaps farther. The genital pinnules (Fig. 15 *d*, *e*) are about 10 mm. long and are usually of 16–19, but exceptionally of up to 24, segments. The distal pinnules are a little shorter and of slightly fewer segments.

Mortensen (1920, p. 32) found as many as eight eggs and embryos in one brood-pouch. That there are much larger numbers in the females of this collection may be seen without dissection or preparation, but one brood-pouch of each of three specimens was examined. The first contained ten eggs and three young embryos; the second, eight eggs and eleven embryos of all ages; the third, six eggs and twenty-one embryos of all ages. The oldest embryos are more fully developed than Mortensen's "full-grown larvae" (1920, pl. xxii, figs. 6–8) for the oral and basal plates are in contact with one another and reach to near both poles; these larvae appear almost completely mail-clad.

A distal pinnule of each of 16 specimens, including two that were immature, was examined. The ambulacral skeleton is usually as Mortensen describes it (1918, p. 13, fig. 12, pl. ii, fig. 5). In four specimens, three mature and one immature, the side- and cover-plates are better developed and the latter are of the bush-like form of those of *I. lineata*. They are best developed in one of the mature specimens (Fig. 15 *f*). Spicules may be very abundant in the tentacles.

In all the specimens in which the disk can be seen it is naked.

Six of the twelve more complete females carry small numbers of pentacrinoids on their cirri.

The single specimen from the Bransfield Strait (St. 175), which is a female with arms over 50 mm. long, is somewhat different. (i) On all the arms P_3 is the first genital pinnule and P_{13} the last; the distal pinnules are of 15–17 segments and about 8 mm. long. (ii) The most expanded segments, the third to the fifth, of the middle genital pinnules are not so wide as those of females from the Falklands and the Burdwood Bank (Fig. 15 *g*). The brood-pouches contain many fewer eggs and embryos. The contents of two were examined: in each there were three embryos and one egg. In one the embryos were as large and as well developed as those described above. (iii) The position of the second syzygy is abnormal: on eight of the arms it is between the eleventh and twelfth, on one between the sixth and seventh, and on the other between the twelfth and thirteenth brachials. (iv) The side- and cover-plates of the pinnule ambulacra are well-developed: the side-plates are plate- not rod-like. There are few spicules in the tentacles.

P_1, of about 12 segments and over 5 mm. long, is slightly longer but not stouter than P_2 which is of about 10 segments and 5 mm. long. The outer brachials and pinnulars have finely thorny distal edges.

Isometra flavescens n.sp. (Plate V, figs. 3 and 4)

St. 160. 7. ii. 27. Near Shag Rocks. 53° 43′ 40″ S, 40° 57′ W. 177 m. Gear DLH. Bottom: grey mud, stones and rock. Six males and six females.

Description. This species is fairly small but robust. The arms of all twelve specimens are broken at the tips. They appear to have been just over 40 mm. long when complete. The specimens are described as having been "mustard-yellow" in colour when alive, and they are still a strong yellow in spirit. In four of the males the yellow colour is overlaid by a dusky shading on the pinnulars, or on the pinnulars and brachials, giving them a dark appearance. The basal segments of the cirri are deep yellow while the distal appear in contrast a pure white.

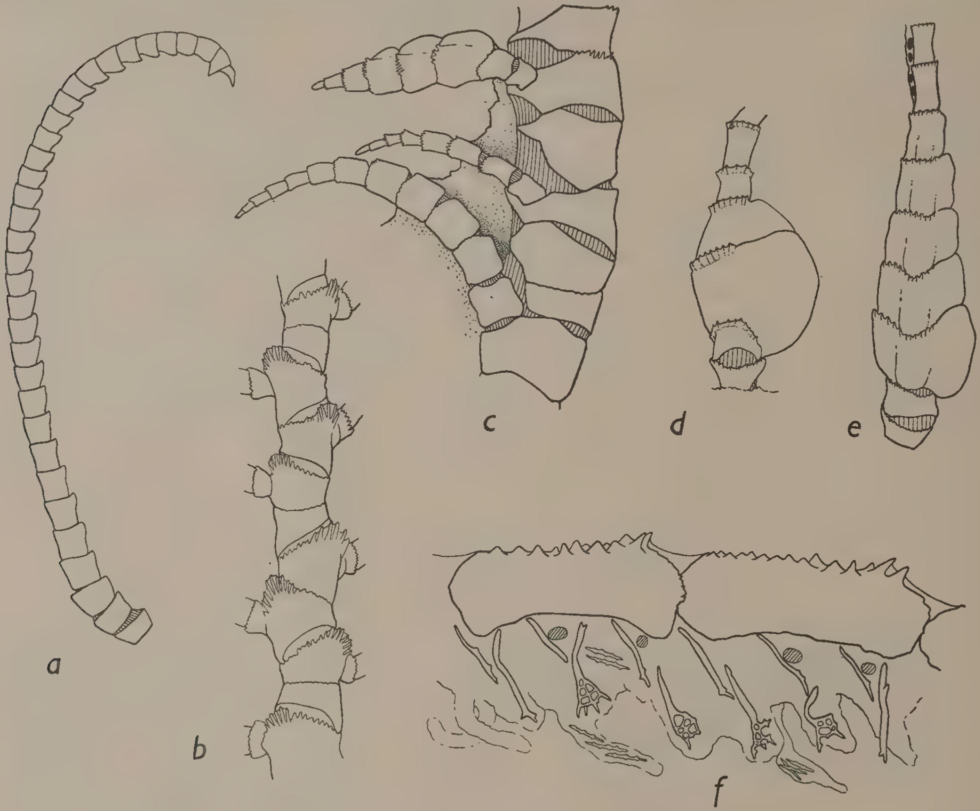

Fig. 16. *Isometra flavescens.* *a*, cirrus. *b*, distal brachials. *c*, proximal brachials and P_1, P_2 and P_3. *d*, a middle genital pinnule of a female. *e*, a middle genital pinnule of a male. *f*, ambulacral skeleton of a distal pinnule. *a–c*, ×11. *d, e*, ×13. *f*, ×66.

The centrodorsal is conical, closely beset with cirrus sockets which may entirely cover it or leave free a small flattened dorsal pole. The sockets are arranged in rows which are regular near the apex but less so near the periphery. The ventral edge of the centrodorsal is slightly produced at the interradial corners.

Cirri XXXVII–XLVII, in one LX; 25–35. They are very like those of *I. vivipara* except that the segments are not so numerous and fewer of them are longer than broad (Fig. 16 *a*). The opposing spine is strong and erect, the terminal claw short and strongly curved.

The radials and primibrachs are of the same shape as in *I. vivipara*. In the three smaller specimens the radials are nearly as long as the costals in their mid-line but in the others they are shorter. The axillary may make a slight shoulder-like projection with the costal where it incises it. In an arm of one male the radial, costal and axillary are represented by one ossicle considerably shorter than the sum of those three ossicles on adjacent arms. The primibrachs and the first two brachials have sharp and nearly straight side edges. The brachials throughout the arm are of a similar shape but they are altogether less smooth. Those between the first and second syzygies have raised distal edges produced into small thorns and they are slightly waisted. The distal edges of the middle brachials, and even more of the outer, are raised and produced into very strong thorny ridges (Fig. 16 *b*).

The first and second syzygies are usually between the third and fourth and the ninth and tenth brachials respectively but there are as many irregularities in proportion to the number of the specimens as in *I. vivipara*.

The pinnules differ from those of *I. vivipara*. P_1 is longer and stouter, sometimes much stouter, than P_2 (Fig. 16 *c*). P_3 is a genital pinnule in most if not all of the arms of both males and females. P_1 is of 9–14 segments and 5–7 mm. long; the first four to six segments are attached to the disk and are in some specimens much heavier than those which follow, and they are in one compressed from side to side. P_2 is of 7–10 segments, 3·5–5 mm. long; its first two to four segments are attached to the arm by a web of tissue.

The species is viviparous and the middle segments of the genital pinnules are expanded as in *I. vivipara*. Because the ends of the arms are broken it is impossible to say how far the genital pinnules usually extend. In one of the smaller specimens, a female, they end at P_{13}, but in a larger male they extend beyond P_{16}. The following are the numbers of segments and the lengths of some genital pinnules:

♀	P_4	9 segments	–
	P_{11}	14 ,,	8 mm.
♂	P_5	11 ,,	–
	P_8	13 ,,	7 ,,
	P_{10}	14 ,,	7·5 ,,
	P_{15}	18 ,,	8 ,,

In the males the expansion of the third and succeeding segments of the genital pinnules is greater and more asymmetrical, being mainly on the aboral side, than in *I. vivipara*. In the females the expansion is confined even on the largest—the middle—genital pinnules to the third and fourth segments (Fig. 16 *d*, *e*).

The segments of all pinnules, except those of P_1 and perhaps some of those of P_2, have strongly thorny distal edges. On the expanded segments of the genital pinnules the thorniness is confined to the mid-line and the adoral side of the distal edges; it is absent from the aboral side where nearly all the expansion lies.

The contents of two typical brood-pouches were dissected out. One contained six eggs and six embryos, the other six eggs and eight embryos. The embryos represent many stages in development. The oldest are similar to and of the same size (0·5–0·6 mm. long) as those of *I. vivipara* having the oral and basal plates in contact with one another (see p. 181).

The ventral surface of the disk, but not the parts between the arm bases, is plated. In none of the specimens could the nature and arrangement of the plates be completely seen without breaking away the arms and this was done with one small male. In it the disk ambulacra are lined by strong plates. At the apices of two of the interradii there are large plates like orals; they cannot be seen at the apices of the other three interradii.[1] The interradii are occupied by some very large, and other small, plates. In the anal interradius two of the large plates are conspicuous; one rests on the perisome and the other, in contact and in line with it, rests on the base of the anal cone, on which there are other plates. In nine other specimens some plates can be seen on the disk, as follows: (i) some light plates on the disk; (ii) and (iii) large plates on the disk; (iv) and (v) heavy plates along the disk ambulacra; (vi) what appear to be oral plates; (vii) a heavily plated anal cone; (viii) two large plates, one at the base of and one on the anal cone, in contact and in line as described above; (ix) the same and other plates on the anal cone. In the two remaining specimens the arm bases are too firmly pressed together for the disk to be seen.

Sacculi are numerous, regular and conspicuous on the arms and pinnules of the dusky coloured males; they are inconspicuous on the other specimens.

The distal pinnules of some specimens have no ambulacral skeleton, but those of others have reduced side- and cover-plates. The most highly developed are shown in Fig. 16 *f*. The side-plates are reduced to rods which may be simple or forked; the basal parts of the cover-plates are simple stems but the ends of most are spread out fan-wise and are reminiscent of those of the other species of *Isometra* with reduced ambulacral skeletons. The tentacles may or may not contain spicules which may be knobbed or smooth, and scarce or abundant.

None of the females carries pentacrinoids on its cirri.

Seven of the specimens were infested with *Myzostomum*, six on the disk, one on the arms.

This species may readily be distinguished from the much larger *I. hordea* by the nature of the oral pinnules and the cirri. It is smaller than *I. vivipara*, more robust though smaller than the largest specimens of *I. graminea*. It differs from both in colour, the nature of the pinnules and the degree of thorniness of the brachials and pinnules. It differs from *I. vivipara*, which has a naked disk, in that its disk is plated; it differs from *I. graminea* in having a more heavily plated disk.

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[1] See p. 187, under *Isometra graminea*.

Isometra graminea n.sp. (Plate V, figs. 5 and 6)

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago. 64° 56′ S, 65° 35′ W. 93–130 m. Gear DLH, NRL. Bottom: ? stones, mud and rocks. A complete female, a specimen with the arms broken off, and parts of the arms of a male and a female.

130–100 m. Gear DLH, NRL. Bottom: ? stones, mud and rocks. One male.

St. 1652. 23. i. 36. Ross Sea. 75° 56·2′ S, 178° 35·5′ W. 567 m. Gear DRR. Bottom: mud. Three males and one female.

St. 1872. 12. xi. 36. Bransfield Strait. 63° 29·6′ S, 54° 03·1′ W. 247 m. Gear N 100 H. Bottom: soft mud. One female.

DESCRIPTION. The male and the female from the Bismarck Strait and the female from the Bransfield Strait are in good condition. The lengths of their arms, from the axillaries, are 40, 40 and 48 mm. respectively. There are larger specimens from the Ross Sea with arms up to 60 mm. long. Notes were made of the colour of some of the specimens when they were captured. The Bransfield Strait specimen was pale straw yellow. Two of the Ross Sea males were "pale yellow brown", one "pale dirty yellow white"; the female was a deep orange brown. The latter is light brown in spirit, whereas the remaining specimens vary from white to yellowish white. The bases of the cirri may be darker in colour and the perisome have a faint greenish tinge.

The centrodorsal is a rounded cone with its ventral edge produced into very slight interradial corners. There is a bare dorsal pole in all except three of the specimens, one from each of the three stations, in which the centrodorsal is entirely covered with cirri. The cirrus sockets are close-set, arranged in alternating rows which may be slightly irregular.

Cirri XXVI–XLIII, 28–41 (Fig. 17 *a*). The lower segments beyond the fourth are longer, except in the specimen from St. 1872, than in *I. vivipara* and *I. flavescens*. There is a slight difference between the cirri of the specimens from the Bismarck and Bransfield Straits and those from the Ross Sea. In the latter the first three cirrals and to a lesser extent the fourth are considerably stouter than the succeeding cirrals; this is not so in the specimens from the other side of the continent. The following description covers those of specimens from both regions. The first two segments are short, the third a little longer. The fourth is longer than broad (except in the specimen from St. 1872). The fifth to about the eighth or ninth are appreciably longer than broad (except in the specimen from St. 1872 in which they are very little longer than broad). The fourth to the eighth or ninth segments may be faintly waisted. The segments beyond decrease in length; the distal are broader than long and each is produced into a moderate or strong rounded dorsal spine. (The figure is of a short cirrus; in the longer, of more segments, many more of those in the distal part are raised into rounded keel-like dorsal spines.)

The radials vary in length. In the smaller specimens they are longer in the mid-line than the costals, but in the largest specimens they are much shorter. The distal edge is wider than the proximal and concave. The costals are not in contact with one another; they are incised by the posterior projections of the axillaries which may form slight shoulders with them. In one specimen, from St. 190, the radials, costals and lower brachials are raised into a keel-like ridge in the mid-line. The ossicles of the division series and the brachials of the proximal part of the arm are narrower and less massive than those of *I. vivipara* (Fig. 17 *b*).

The side edges of the axillaries and lower brachials are sharp and straight. The brachials are of the same shape, the positions of the first two syzygies are the same and other syzygies are as numerous, as in *I. vivipara*. The distal edges of the outer brachials are raised into moderately strong and conspicuous spines.

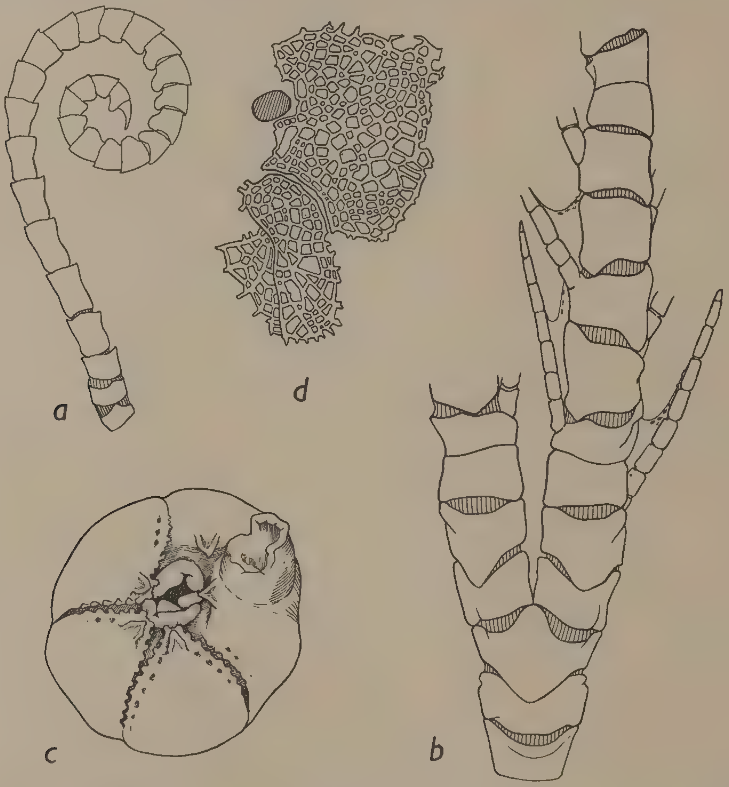

Fig. 17. *Isometra graminea*. *a*, cirrus, ×13. *b*, proximal part of a ray, ×13. *c*, disk, in which the anal cone is broken and two of the ambulacral grooves imperfectly seen, ×11. *d*, a side- and a cover-plate of a distal pinnule, ×66.

The oral pinnules differ from those of *I. vivipara* and *I. flavescens*, for P_2 is as stout and as long as, or longer than, P_1, and P_3 is longer than P_2. P_1 and P_2 are of 8–10 segments and 3–6 mm. long, depending on the size of the animal; P_3 is of 9–12 segments, 3·5–7 mm. long. The first three or four segments of P_1 are attached by a web of tissue to the disk, and the lower segments of P_2 and P_3 are similarly attached to the arm. The first genital pinnule is P_4 or P_5, of about 10–12 segments; the last is P_{13} to P_{16}, of about 15 segments and 7–9 mm. long.

The species protects the brood like *I. vivipara* and *I. flavescens* and, as in those species, the third and fourth segments of the genital pinnules of the females are enormously expanded, mainly on the aboral side, to cover the ovary and brood-pouch. In the middle genital pinnules the fifth segment is expanded to a smaller degree.

The third and succeeding segments of the male genital pinnules are expanded to cover the testes. The expansion is a little stronger on the aboral than the oral side, but it is not so asymmetrical as, and it is much smaller than, in the female; the expanded segments gradually merge into the unexpanded distal segments.

The contents of one brood-pouch of the female from the Palmer Archipelago were examined. There is one egg, one larva similar to that of *I. vivipara* figured by Mortensen as a full-grown larva (1920, pl. xxii, fig. 8), and three other larvae with the plates better developed so that the orals and basals touch one another—a stage intermediate between Mortensen's figures 8 and 9 (*ibid.*). They are of the same size as those of *I. vivipara*. Similar larvae occur in the brood-pouches of the female from the Ross Sea; in one brood-pouch there were seven. Those of the specimen from St. 1872 are younger.

On the disks of the Palmer Archipelago specimens there is at the apex of each interradial area a sharp calcareous plate with its apex projecting over the peristome[1] (Fig. 17 *c*). A broad depression runs radially along each plate because its sides are curled upwards. The bases of the plates are not distinct but they appear to be straight. Similar plates are present in one of the Ross Sea specimens and appear to be present in two others; in the fourth, and in the specimen from St. 1872, the disk cannot be seen. Clark (1915 *b*, pp. 340–1) says that the oral plates of young comatulids "are always resorbed long before adult life is reached, no trace of them whatever remaining"; these plates of *Isometra graminea* must therefore be, what Clark calls in the same place, secondary perisomic orals, though he describes them as occurring only in certain species in which the disk is heavily plated; there are no other plates on the disk of *I. graminea*.

The sacculi are inconspicuous. They are often fairly regular on the pinnules, less so on the arms; they occur on the disk.

The pinnule ambulacra are protected by large side- and cover-plates (Fig. 17 *d*), three pairs to each segment. The side-plates overlap one another so as to make a continuous wall: the divisions between them are difficult to see. The cover-plates are more rounded with a fan-like system of supporting rods terminating in peripheral spikes; in this they somewhat resemble the cover-plates of *I. lineata*, *I. angustipinna*, *I. vivipara* and *I. flavescens*. The tentacles contain strongly knobbed spicules.

The species is altogether less robust than *I. vivipara* and *I. flavescens*, and may easily be distinguished from them by the differences in the proportionate sizes of the oral pinnules. It is as readily distinguished from the much more robust *I. hordea* by the differences in the cirri.

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[1] All five plates are easily seen in the broken specimen. Two can be seen in the female and one in the male between the more widely separated arms: I have no doubt there are five present.

Isometra hordea n.sp. (Plate V, figs. 7 and 8)

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ W. 342 m. Gear DLH. Bottom: rock. Three specimens.

St. 1873. 13. xi. 36. Off Cape Bowles, Clarence Island. 61° 20·8′ S, 54° 04·2′ W. 117 m. Gear DRR. Bottom: rock and stones. One specimen.

St. 1948. 4. i. 37. East of Clarence Island. 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. Four specimens.

St. 1955. 29. i. 37. North of South Shetland Islands. 61° 35·1′ S, 57° 23·3′ W. 440–410 m. Gear DRR. Four specimens.

Description. The larger specimens are moderately big and massive but they appear to be more brittle than the smaller for none of them is complete. The longest remaining arm of the stoutest specimen consists of 42 brachials and measures 45 mm. A much younger and slighter specimen has one complete arm of 93 brachials, 56 mm. long.

The centrodorsal varies from a low rounded hemisphere to a high rounded cone and it is usually covered with closely crowded cirrus sockets arranged in alternating rows (Fig. 18 *b*). The dorsal pole may be large or small and either smooth or so beset with tubercles as to be very rough; or there may be no bare dorsal pole. The ventral edge of the centrodorsal is usually straight but it may be produced into low interradial corners.

The centrodorsal of the largest most massive specimen (St. 1948) is remarkable. It is a high rounded cone. The only cirri remaining are three or four rows around the ventral edge yet they number 52. Over all the rest of the surface, excepting the small smooth dorsal pole, the cirrus sockets have become quite obliterated by a honey-comb-like growth of stereom.

Cirri XL–LX; 25–70. They are of two sizes: there are short apical cirri and peripheral cirri which may be twice as long. In the smaller specimens the apical cirri are of 25–35 segments and 10 mm. long, the longer outer cirri are of 38–50 segments and 20 mm. or more in length. In the larger specimens the apical cirri may be of up to fifty segments and 16 mm. long; the peripheral cirri are of 50–70 segments and up to 40 mm. long. The following is a description of the peripheral cirri of large specimens (Fig. 18 *a*).

The first four segments are considerably broader than long, the fifth about three-quarters as long as broad. The sixth to about the twelfth are very slightly longer than broad. Four or five beyond the twelfth are as long as broad. Thereafter the segments gradually decrease in length until the distal, which may be twice as broad as long. The long proximal segments are perfectly regular. In the region of the twelfth to fifteenth segments a small swelling appears at the distal end of the dorsal edge. By the twenty-fifth or so it has developed into a long low keel with a straight edge occupying the distal three-quarters of the dorsal edge. On the shorter distal segments the keel is shorter with a curved edge. It becomes weak on the three or four segments before the opposing spine. The opposing spine is usually strong and upstanding, the terminal claw moderately strong. There is a sharp difference in colour between the first six to ten segments, which are yellow, and the others which are white. In two specimens the four or five most distal segments of some cirri are a deep brown.

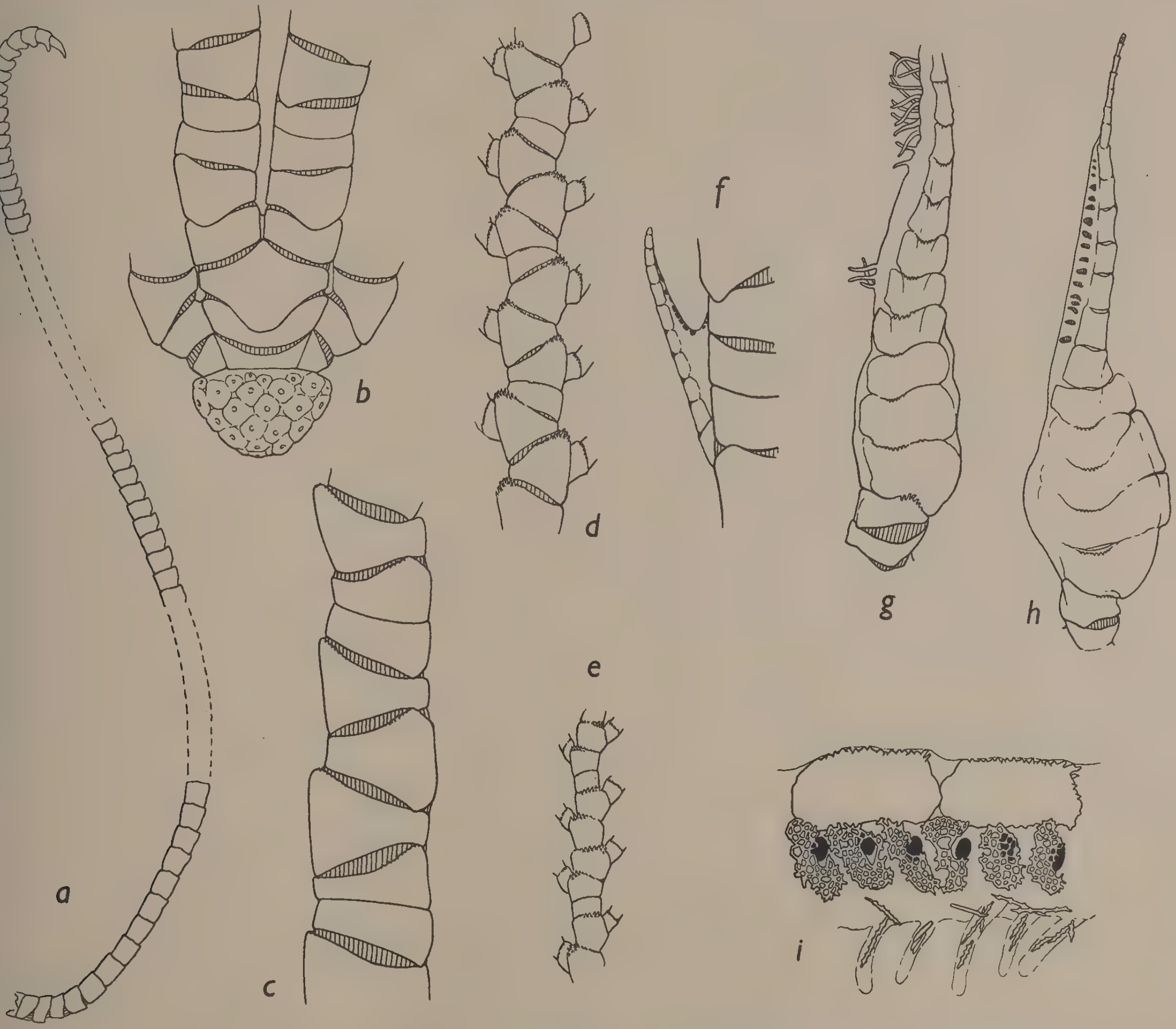

Fig. 18. *Isometra hordea*. *a*, cirrus, ×4. *b*, centrodorsal and proximal parts of rays, ×7. *c*, brachials of third syzygial pair and beyond, ×13. *d*, thirty-first to forty-fifth brachials, ×11. *e*, sixtieth to seventieth brachials, ×11. *f*, P_1, ×11. *g*, a middle genital pinnule of a male, ×8. *h*, a middle genital pinnule of a female, ×8. *i*, ambulacral skeleton of distal pinnules, ×60.

Smaller cirri, whether of large or of small specimens, resemble the above, but there are fewer segments longer than broad and the dorsal keel begins sooner.

The radials are short even in young specimens; they are very short in the older. (Fig. 18 *b* is of a specimen of medium size having complete arms of about 90 brachials which are 58 mm. long.) They are wider distally than proximally and have concave distal margins. The costals are three to four times as broad as long. They are not incised by the axillaries: they are bent back beneath its posterior projection. In older specimens they are bent back farther than in the figure, so far that their mid-line, seen in profile, is in line with the base of the centrodorsal. The costals of younger specimens are not in opposition, those of older specimens are. The axillary is considerably broader than long in younger specimens but nearly as long as broad in the older in which the posterior projection is more strongly developed. The outer edges of the costals and axillaries are straight and sharp.

Syzygies are numerous. The normal positions of the first three are 3 + 4, 9 + 10, 15 + 16, but there may be small irregularities. Beyond the third syzygy the syzygial pairs are separated by two or three, or exceptionally one or four to six, brachials.

The outer edges of the lower brachials are sharp and their sides flat. The exterior edges of the first brachials are longer than the inner; the inner are in partial or complete contact. The first brachial is only slightly incised by the second in younger specimens, more deeply in older specimens. The outer edge of the second brachial may be twice as long as the inner. The inner edge of the first syzygial pair is longer than the outer. The brachials between the first and second syzygies are considerably broader than long and longer on one side than the other—on alternate sides in successive brachials. An obvious feature of older specimens is the strong moulding of these and a few succeeding brachials. Their surfaces are not flat: the inner distal corner of the fourth brachial (an epizygal) is raised, in common with the inner proximal corner of the fifth brachial, into a prominence; the outer distal corner of the fifth brachial and the contiguous corner of the sixth brachial are raised into a similar prominence; and so on. The surfaces of these lower brachials are quite smooth.

From the second to the fourth syzygies the brachials become more wedge-shaped. The distal edges of the outermost may be slightly everted and produced into fine spines (Fig. 18 *c*). The shape of the brachials then passes to that of a rounded triangle; the base slopes across the arm and the rounded apex, produced into a strongly overlapping edge armed with strong spines, is directed towards the side from which the pinnule arises. The zigzag appearance may be stronger than that shown in Fig. 18 *d*. In the distal brachials the shape again becomes quadrangular; the distal edges remain strongly everted and spiny (Fig. 18 *e*).

The pinnules gradually increase in length from P_1 to the distal pinnules; they become shorter again towards the tip of the arm. P_1 is short and stout, 4–5 mm. long and of 10, 11 or 12 smooth rounded segments which are longer than broad (Fig. 18 *f*). P_2 is similar and of the same number of segments but slightly longer and stouter, 5–8 mm. long. P_3 is similar, of 11–13 segments and slightly longer. P_4 may be similar to P_3 or it may be the first genital pinnule. As in the other species of *Isometra* the oral pinnules are not entirely free. P_1 is attached to the disk by its first four or five segments, and the first four or five segments of P_2 and P_3 are connected by webs of tissue with the under side of the arm.

This species, like the other Antarctic *Isometras*, is viviparous. The first genital pinnule is P_4, P_5 or exceptionally P_6, of up to 15 segments and of the same length as, or slightly longer than, the last oral pinnule. The genital pinnules extend to P_{13} in smaller specimens, P_{18} in larger, and the last of them may be of 18–26 segments and 9–14 mm. long. The first two segments of the genital pinnules are short and stout with the aboral portions of their distal edges produced into spines. The segments carrying the gonads are much more strongly expanded in the female than the male. In the smallest specimen, which has arms 35 mm. long, none of the segments of the genital pinnules is expanded.

In the largest male the testes of the middle genital pinnules lie along the third to eighth segments and they are expanded, more strongly on the aboral than the oral side (Fig. 18 *g*). The testes of the lower and outer genitals of big males, and those of younger males, are smaller and consequently fewer segments are expanded. The third or the fourth segment is the widest and longest. The remaining segments along which the testes lie decrease in width gradually and evenly. The expanded segments are raised into a keel-like crest in the mid-line. The narrow portion of the distal edge which is a part of the crest may be thorny. The distal segments beyond the gonad are strongly compressed.

There are three females. In the smallest only the third to fifth segments of the genital pinnules are expanded, as in *I. vivipara*; the expansion appears to be a little less on the aboral side than in *I. vivipara*. In the largest, a massive but broken specimen, many of the genital pinnules (at least from P_7–P_{10}) have five segments, the third to seventh, expanded; in a few pinnules the eighth segment is slightly expanded (Fig. 18 *h*). The expansion of the segments of one pinnule is not always even: not infrequently the sixth segment is very narrow on the aboral side, the corner of the fifth being produced alongside it, sometimes so much so as to meet the seventh. Other similar irregularities occur. In the female, as in the male, the expanded segments are raised into a crest in the mid-line.

The ovary is a long fusiform body lying along the adoral side of the pinnule. It is longer than the brood-pouch and the strongly expanded segments: in a pinnule in which the brood-pouch lies along the third to sixth segments and they are strongly expanded, the ovary extends to the eighth segment. In the largest female the brood-pouches are empty. In one of medium size they are crowded with embryos and so large that they bulge out beyond the edges of the expanded segments. A transverse depression runs across the ventral face of the brood-pouch: it is due to a septum which divides the pouch into two equal compartments. Its purpose appears to be to support the brood-pouch for the contents of the two compartments are similar. One brood-pouch of the medium-sized specimen was examined. The proximal compartment contained fourteen embryos of which thirteen were young and without skeletal plates; the fourteenth contained skeletal plates. The distal compartment contained ten embryos without plates. The brood-pouches of the third and smaller specimen are smaller: the proximal compartment of one contained four embryos in one of which there are plates; the distal compartment contained four embryos of which three have plates.

The embryos vary from 0·5 to 0·8 mm. in length. Some of the younger are of very irregular shape where they have been tightly packed against their neighbours. In the largest embryos the sucking disk and vestibulum are clearly marked; the oral plates and the basal plates are nearly in contact with each other and one another. I cannot see infrabasals; there are about 20 stem-plates and a very large terminal plate. The basal circle embraces the stem. I have seen bands of cilia around some of the embryos.

Most of the distal pinnules are of the same number of segments and length as the outer genital pinnules but they become shorter towards the end of the arm. (In small specimens they are of 16–20 segments, 8–10 mm. long.) The first two segments are short and stout with strongly spiny distal edges. The remainder, but for the last four or five, are strongly compressed from side to side and gradually taper; their distal edges are beset with fine spines. The ambulacral furrow does not extend on to the last four or five segments; they are slender and rounded and strongly spiny.

The disk appears to be naked in the few specimens in which parts of it can be seen, the anal cone high.

Sacculi are abundant and conspicuous, regularly arranged on the disk, the arms and the pinnules; in some of the specimens they have retained in spirit a beautiful red colour.

Along the pinnule ambulacra of the small- and medium-sized specimens there are heavy well-developed side-plates, about three pairs to each segment, but no cover-plates (Fig. 18 *i*). Spicules occur in most of the tentacles; they may be simple smooth rods, but are more often very thorny and are sometimes branched. The large specimen lacks distal pinnules; there are no side plates along its genital pinnules but there are abundant spicules in its tentacles.

Notes of the colour of five of the specimens were made at the time of capture. Four of them were lighter in the proximal than the distal part. The proximal third to half varied from straw-yellow to bright orange yellow; the distal part from a delicate pink to a deep orange brown. The fifth specimen was orange yellow. The specimens retain yellow or pink tinges, deeper in the more distal part, in spirit. The basal segments of the cirri are darker in colour than the rest.

A series of pentacrinoid larvae of this species is described on pp. 202–210.

This is by far the largest and most robust species of *Isometra* (Plate V). It is distinguished from all others by its longer cirri made up of more numerous segments. From *I. vivipara* which most nearly approaches it in size, and from *I. flavescens* which is smaller, it is further distinguished by differences in the proportional lengths of the oral pinnules.

Family *NOTOCRINIDAE*

Genus **Notocrinus** Mortensen

Notocrinus virilis Mortensen (Plate VI, fig. 1)

Mortensen, 1918, pp. 2–10, figs. 1–5, pl. i, figs. 1–5, pl. ii, figs. 1–4, pls. iii–iv. 1920, pp. 49–53, fig. 7, pls. xxiv–xxvi. Clark, 1921, many references, pl. 49, figs. 1329–30, pl. 55, figs. 1349–52. Clark, 1929, p. 664. Grieg, 1929 *a*, p. 5. Clark, 1937, p. 16.

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ W. 342 m. Gear DLH. Bottom: rock. Seventeen specimens.

St. 175. 2. iii. 27. Bransfield Strait, South Shetlands. 63° 17′ 20″ S, 59° 48′ 15″ W. 200 m. Gear DLH. Bottom: mud, stones and gravel. Seven specimens.

St. 1658. 26. i. 36. Off Franklin Island, Ross Sea. 76° 09·6′ S, 168° 40′ E. 520 m. Gear DRR. One specimen.

St. 1948. 4. i. 37. East of Clarence Island. 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. One specimen.

All but one of the twenty-six specimens of this robust species are in good condition. Six have arm lengths of between 100 and 130 mm., nine of between 80 and 95 mm., five of between 60 and 75 mm., four of between 40 and 55 mm., and the smallest is 28 mm. long. The largest are, I think, bigger than any of the Swedish Expedition's collection and it is perhaps for that reason that I have to make some of the small additions that follow to Mortensen's full description.

The radial may be longer than the costal as in Mortensen's figure (1918, pl. ii, fig. 1), or of the same length or shorter.

The examination of the cirri of the specimens of this collection leads to the following numerical description, wider than Mortensen's, of the cirri: XXI–XLII, 36–76. There is a distinct and sharp change in colour between the proximal and distal cirrus segments: the first eight to thirteen are of a deep straw colour which may be tinged with red; those beyond are nearly white.

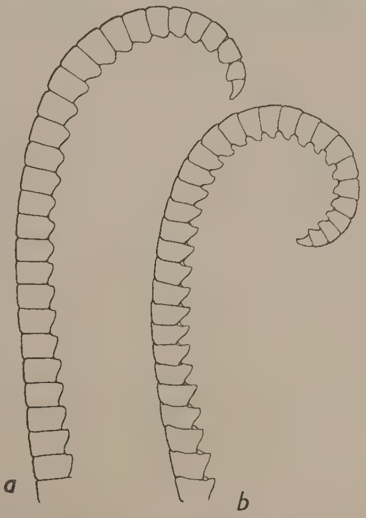

Fig. 19. *Notocrinus virilis*. *a*, distal part of cirrus from specimen from Graham Land region, × 5. *b*, same from specimen from Ross Sea, × 5.

There are in the Museum collection two specimens of this species, from the Terra Nova station 295 (348 m.) in the Ross Sea, which, unlike that recorded by Clark (1929, p. 664) from the same region, retain their cirri. They, and those of the single specimen of the present collection which comes from the Ross Sea, differ from those of typical specimens from the Falkland Sector of the Antarctic in that the dorsal prominences of the distal segments are more strongly developed and spine-like, as a comparison of *a* and *b* in Fig. 19 will show. Some of the cirri of large Falkland Sector specimens may, however, have dorsal prominences nearly as big as those of Ross Sea specimens.

As in *N. mortenseni* (see below) the oral pinnules are not entirely free. P_1 and P_a are attached to the disk by their first three to five segments; the first three to four segments of the other oral pinnules are attached by a web to the tissues of the arm. In all but the smallest specimens P_1 is of 11–16 segments, 6–10 mm. long; P_2 of 11–18 and P_3 of 12–20 segments, each 6–11 mm. long. In the smallest specimens the oral pinnules are of slightly fewer segments. The first genital pinnule is P_3 or P_4; the last may in large specimens be so far out as P_{27}. The outer pinnules may be up to 20 mm. in length.

The syzygies are more irregularly arranged than Mortensen records. The first is abnormally placed on certain of the arms of seven specimens: on one arm it is $2+3$, on six $4+5$, on two $8+9$, and on one so far out as $18+19$. On arms where the first syzygy is normally placed there are examples of the second occurring between almost every pair of brachials between the fifth and the twenty-second. There are three examples of the first syzygial pair $(3+4)$ being immediately followed by another, $5+6$, and in each the pinnules are abnormal. Two are on arms of the specimens from St. 1948. In one the epizygal of the first pair, in the other the epizygal of each pair, bears two pinnules, one on either side. The third example is on an arm of the Ross Sea specimen (St. 1658) where the first three syzygial pairs are $3+4$, $5+6$, $7+8$; the epizygal of the second pair bears two pinnules, one on either side.

The sacculi are usually inconspicuous but in some specimens are of a dark brown colour.

Some of the embryos are bigger than those seen by Mortensen, as much as 2 mm. long, but all seem to be at the same stage of development. Mortensen found no pentacrinoids but suggested that they may attach themselves to the walls of the marsupia as in *Phrixometra nutrix*. There is none so attached to the females of this collection and I do not think they have this habit, for from Sts. 170 and 175 come twenty pentacrinoid larvae, one attached to the cirrus of an adult *Notocrinus virilis*, the remainder to foreign bodies, which are certainly of *N. virilis*. They do not include any of the younger, prebrachial stages. The series is described on pp. 210–219.

Distribution. The species appears to be circumpolar in distribution for it is known from the South American, the Indian Ocean and the Ross Sea sectors of the Antarctic. It has been taken from depths between 80 and 650 m.

Notocrinus mortenseni n.sp. (Plate VI, fig. 2)

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ W. 342 m. Gear DLH. Bottom: rock. Two specimens.

St. 187. 18. iii. 27. Neumayr Channel, Palmer Archipelago. 64° 48′ 30″ S, 63° 31′ 30″ W. 259–354 m. Gear OTL. Bottom: mud. One specimen.

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago, 64° 56′ S, 65° 35′ W. 315 m. Gear DLH. Bottom: mud and rock. Three specimens. 130–100 m. Gear DLH, NRL. Bottom: mud, stones and rock. One specimen. 93–130 m. Gear DLH, NRL. Bottom: mud, stones and rock. Two specimens.

St. 1948. 4. i. 37. East of Clarence Island. 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. One specimen.

Description. The largest specimen has arms 105 mm. long. The single specimen from St. 1948 has shorter but much more massive arms; it is considerably older than any of the others and is as robust as big specimens of *N. virilis*. The species has much shorter cirri, shorter stouter pinnules and smaller gonads, than *N. virilis*.

The centrodorsal may be conical or hemispherical with a bare and smooth dorsal pole (Fig. 20 *a*). The ventral edge is produced into small corners or low wide projections interradially. In some of the younger specimens the corners are raised into ridges free of cirrus sockets; in the others and in the older specimen they are occupied, like the rest of the centrodorsal, with closely placed cirrus sockets.

Cirri XXXVIII–LX or more, 21–32 (Fig. 20 *b*). The cirri are composed of stout segments and they are strongly curved; having but half as many segments as those of *N. virilis* they are much shorter in proportion to the size of the animal. Their segments are not uniform in length as in *N. virilis*. The first three are short, the fourth or fifth is as long as broad. The fifth or sixth to the ninth or twelfth are longer than broad—less so in old specimens than in Fig. 20*b*, which is from a young specimen. Those beyond gradually become shorter until the distal are wider than long. On one of the segments between the sixth and the fifteenth a small projection appears at the distal end of the dorsal side; it gradually develops into a strong low keel occupying nearly the whole of the dorsal side of the more distal segments. The terminal claw is small and the opposing spine is not well developed: when most strongly developed it is more keel- than spine-like. In the old specimen both claw and spine are much smaller than in the figure. The cirrus segments may be all of one colour, white or dirty white; or the first six or more may be of a darker colour, usually yellow, than the distal. The last three or four, including the terminal claw, may also be dark in colour.

No basal plates are visible.

The shapes of the radials, costals, axillaries and lower brachials of the younger specimens are shown in Fig. 20 *a*. The radials are large and in lateral contact; the contact is not always complete as in the figure, the distal corners may be free. The proximal margin of the radial is convex; the distal edge is wider and concave. The costals are not in contact with one another. Each forms a shoulder with the posterior projection of the axillary which incises it. The costals are narrower distally than proximally. The proximal edges of the axillary are nearly straight, the distal are concave.

The radials and the costals are of very different shapes in the old specimen from St. 1948. The radials are reduced to narrow strips, perhaps one-tenth as long as wide. The costals are in lateral contact for about half their length; the lateral edges of the distal half bend sharply inwards towards the axillary so that the distal width of the ossicle is about three-quarters of the greatest proximal width.

Syzygies are numerous. The first is normally between the third and fourth brachials but in one arm of one specimen it is between the eleventh and twelfth. The second is usually between the ninth and tenth though it occurs also between the sixth and seventh, the eighth and ninth, and between every pair from the tenth to the sixteenth. The third is usually between the fourteenth and fifteenth and those beyond are numerous to the end of the arm with one to four or more brachials between each pair.

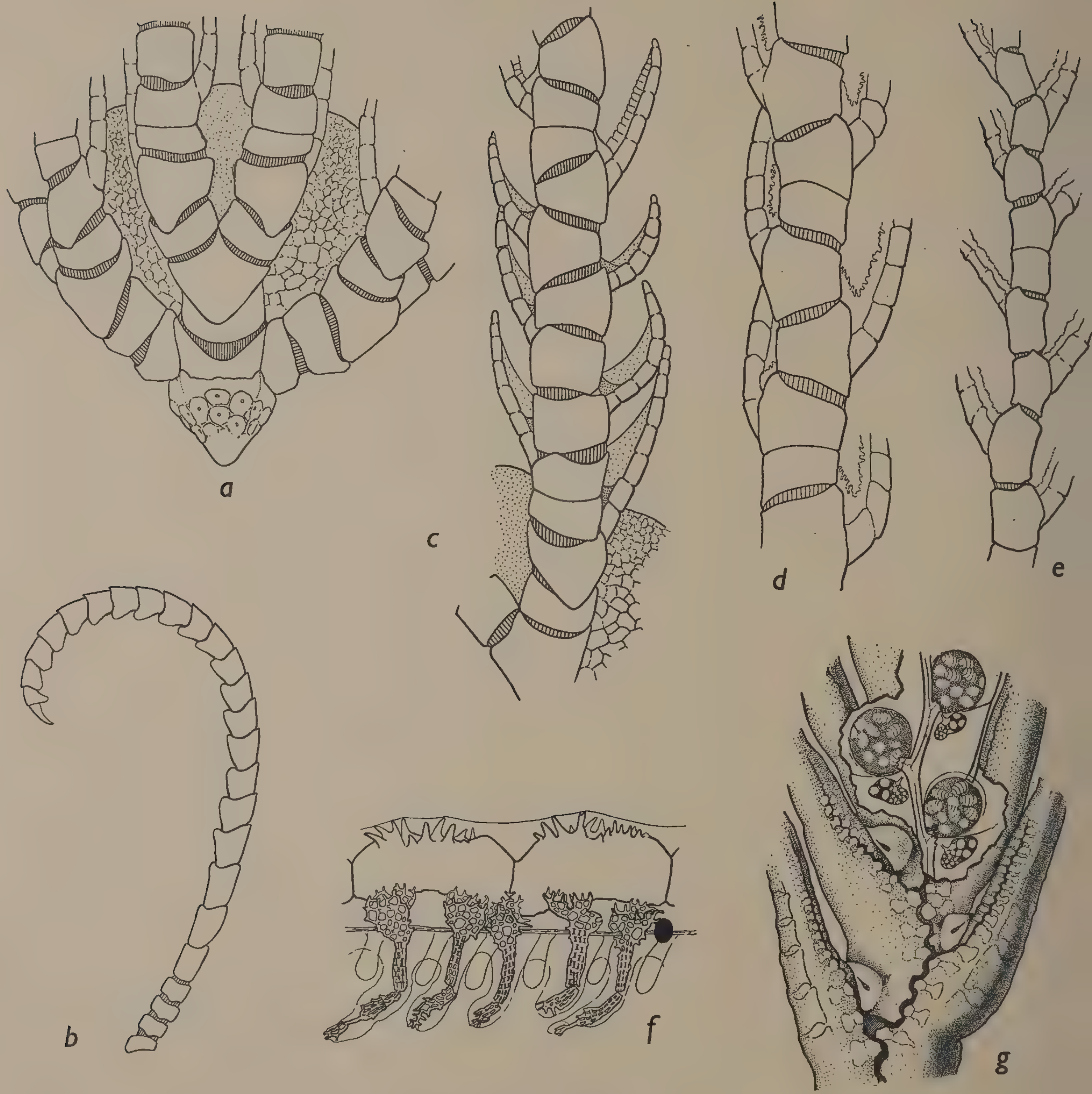

Fig. 20. *Notocrinus mortenseni*. *a*, centrodorsal and proximal parts of three rays, ×7. *b*, cirrus, ×7. *c*, first twelve brachials of an arm with pinnules, ×7. *d*, brachials of the middle part of an arm, ×11. *e*, distal brachials, ×11. *f*, ambulacral skeleton of a distal pinnule, ×40. *g*, ventral view of a portion of an arm of a female in the region of the genital pinnules; in the upper half the skin has been cut away to show the ovaries and brood-pouches, ×7.

The arms of the longest specimens are composed of about 114 brachials. The first brachial is slightly incised by and much shorter than the second (Fig. 20 *c*). The two beyond the first syzygial pair, the fifth and sixth, are almost rectangular and, more especially in the larger specimens, broader than long. Those beyond, to the third syzygy, are wedge-shaped, almost triangular, and nearly as long as broad. The distal become less triangular and more quadrate and, towards the end of the arm, as long as or longer than broad (Fig. 20 *d*). Towards the end the arm has a zigzag shape because each brachial bends to the side from which its pinnule springs (Fig. 20 *e*).

The oral pinnules (Fig. 20 *c*) are short and stout and taper to blunt ends. They are composed of a small number of rounded segments each of which, except perhaps for the first, is slightly longer than broad. P_1 is always heavier and slightly longer than P_2 and P_3, which are of the same length. In the younger specimens P_1 is of 8–10 segments, 5·5–7 mm. long; P_2 and P_3 are of 7–10 segments, 5–6 mm. long. In the old specimen from St. 1948 P_1 is of 13 segments and 11 mm. long, P_2 and P_3 are of 12 segments and 9 mm. long. P_4 is usually an oral pinnule and variable even on the different arms of a single individual: it is of 7–12 segments, sometimes of the same length as, most often longer than, P_2 and P_3. It is sometimes a genital pinnule of more segments and greater length.

P_1 is not entirely free: its first two to four segments are directly attached to the disk and one or two beyond are connected with the disk by a web of tissue. The first segments of the other oral pinnules are similarly attached to the arms by webs of tissue.

The number of genital pinnules on one side of the arm varies in the nine younger specimens from eight to nineteen and is twenty-three in the older specimen. The gonads lie at their bases as in *N. virilis* (see below). The first genital pinnules are longer than the orals and they gradually increase in length. The most distal genital and the first of the outer pinnules are the longest; those beyond decrease in length to the tip of the arm. P_5 is usually the first genital pinnule; it is of 11 segments and about 8 mm. long in the younger specimens, of 17 segments and 12 mm. long in the old specimen. The distal genitals are of 17–22 segments, 12–14 mm. long. The pinnules at the tips of the arms may be of only 9 or 10 segments, about 10 mm. long.

The genital and outer pinnules are composed of round segments the first one or two of which are as long as broad, the others slightly longer than broad. Their distal edges may be produced into a row of fine spines. The ends of the pinnules are often strongly curved. The dorsal sides of the last three or four segments are arched.

The disk is incompletely plated. There is a close pavement of thin plates completely or almost completely covering the space between the bases of the arm pairs of the younger specimens: in the older specimen the plates are few and isolated; there are usually no plates on the small part of the disk to be seen between the two arms of one pair. On the ventral side of the disk of the younger specimens the plates are fewer and larger. There are one or two large plates at the oral corners of each interradius and rows of large plates along the ambulacral grooves. The anal cone is covered with small plates. The ventral side of the disk of the older specimen cannot be seen.

Side- and cover-plates are well developed along the arm and pinnule ambulacra. There are two to three pairs of each to every pinnular (Fig. 20 *f*). The side-plates have a wide base produced into a column, to the ends of which the long and narrow cover-plates are attached. In the older specimen the bases of the side-plates along the lower segments of the pinnules are reduced.

Sacculi are very few and inconspicuous, widely and irregularly spaced.

The gonads lie as in *N. virilis* in the angles between the pinnules and the arms. Only two of the specimens are males; both are rather small and probably far from physically mature. Their testes are very much smaller and less conspicuous than those of *N. virilis* though they are easily seen from the side. They are about 1–2 mm. long, triangular in shape, lying with one side along the first two segments of the pinnule and another along the arm. Regarding the side which runs along the arm as the base, there is near the apex, but slightly below it on the inside, a small papilla through which I assume there is a pore for the passage of the spermatozoa to the outside.

The female reproductive organs consist of ovaries and brood-pouches as in *N. virilis* (Fig. 20 *g*). In the younger specimens the brood-pouch does not touch the ovary of the next pinnule on the same side of the arm; in the older specimen from St. 1948 (which is a female) it does. The ovaries are oval, less than 1 mm. long in the younger specimens, about 1·5 mm. in the older. Each lies at the base of the pinnule, resting against it and the arm, and is not usually visible behind the base of the pinnule from the outside. The brood-pouch lies in the angle between the arm and the pinnule, separated from the ovary by a thin septum in which there is a large round pore. Larvae escape from the brood-pouch by a slit-like orifice on the inside. The brood-pouches are easily seen from the outside and their walls are so thin that the embryos, and the ciliated bands of the most developed, may be seen through them. There are many more though much smaller embryos than in *N. virilis*. In the larger brood-pouches of the younger specimens there may be over 30 embryos; one of the lower brood-pouches of the older specimen was dissected out and found to contain no less than 92 embryos. The embryos vary in size from 0·25 to 0·48 mm. The smallest are globular and only a little larger than the biggest eggs in the ovary; the largest are oval with five broad bands of cilia: they are fully formed larvae at much the same stage of development as those of *N. virilis* described by Mortensen (1920) which are four times as long and have no trace of ciliated bands. They presumably pass on to a free-swimming stage before settling down and changing into pentacrinoid larvae. The older embryos are found in the distal part of the brood-pouch, the younger in the proximal part near the ovary.

One brood-pouch may contain every stage between the egg and the fully formed larva. I have not worked out the development. The fully-formed larva has two circles of plates, the orals and basals, and at least two infrabasal plates. There are six to eight stem joints; I see no supplementary terminal plates.

The younger specimens are of a pale straw colour in spirit; the older has a dusky hue. Some *Mvzostomum* were found on the genital pinnules.

This species may readily be distinguished from *Notocrinus virilis* by its cirri. They are shorter, of about half as many segments, and the segments are not of uniform length as in *N. virilis*.

Family *COMASTERIDAE*

Comanthus novaezealandiae A. H. Clark

Genus **Comanthus** A. H. Clark

Comanthus novaezealandiae Clark, 1918, p. 42; Mortensen, 1925 *a*, pp. 387–8, figs. 64–5; Clark, 1931, p. 588.

St. 934. 17. viii. 32. Off Three Kings, North Island, New Zealand. 34° 12′ S, 172° 11′ E. 92–98 m. Gear OTL. Bottom: hard, comminuted shells and bryozoans. One young specimen and fragments of an older specimen.

St. 935. 17. viii. 32. Off Three Kings, North Island, New Zealand. 34° 11′ S, 172° 8′ E. 84 m. Gear DRL. Bottom: hard. Two large specimens.

The young specimen has only 12 arms; one of the larger has 16, the other 17, arms. The longest remaining arm, which is incomplete, of the largest specimen is of 116 brachials and nearly 100 mm. long.

The cirrus sockets are irregularly arranged, here in a single, there in a double, row around the edge of the centrodorsal. There are 38 and 34 in the larger specimens, 18 in the young specimen. The cirri are of 16–18 segments in the larger specimens. The seventh segment is a transition segment with its distal quarter a dirty white like the succeeding segments, the remainder a darker colour like the segments proximal to it. The segments beyond the seventh are less rounded and conspicuously wider laterally than the others; the dorsal spine develops rapidly beyond the seventh segment.

Mortensen has figured the oral and genital pinnules. P_1 is of 34–38 segments and about 8 mm. long; P_2 is similar and nearly as long. The terminal comb of the oral pinnules is double, for the inner ventral edges of the last 10–12 segments carry blades similar to but slightly smaller than those on the outer ventral edges.

P_3, of about 15 segments, is much shorter than the oral pinnules—4–5 mm. long. The outer genital pinnules are of 18 segments and about 7 mm. long. The distal pinnules are of longer segments, 20–25 in number, and are as long as the orals. The distal dorsal edges of the third to the fourth or fifth segments of the genital and outer pinnules are raised into strong thorny protuberances. The remaining segments are smooth except for a varying number of the distal segments, a smaller number in the outer than the genital pinnules, which are raised dorsally into spines which may be high and recurved.

The distal edges of the brachials are raised and produced into fine spines. The syzygial pairs are usually separated by three brachials.

PENTACRINOID LARVAE

There are thirty-eight pentacrinoids belonging to three species, *Promachocrinus kerguelensis*, *Isometra hordea* and *Notocrinus virilis*, in the collection. There are only three of *Promachocrinus kerguelensis*, but good series, fifteen and twenty respectively, of

Isometra hordea and *Notocrinus virilis*. In describing them I have followed A. H. Clark in calling the plate in the posterior interradius the *radianal* plate: it is the anal plate of other authors.

Mortensen (1920, p. 74) says that it appears to be a general rule among comatulids that: the anal (radianal) plate develops in the radial midline like the true radials but before any of them; the right posterior radial is the last of the radials to develop; it appears to the right of the anal plate and outside the radial midline, and only later, during growth, assumes the radial position by pushing the anal plate to the left.

Clark has described a long series of *Promachocrinus kerguelensis* pentacrinoids containing specimens much younger than mine. There is not in my series of *Isometra hordea* and *Notocrinus virilis* any specimen with the radianal plate but with no right posterior radial. Nevertheless the younger stages of *Isometra hordea* do appear to confirm Mortensen's general rules.

In specimen No. 2 of *Isometra hordea* all the radials are present, but the right posterior is smaller than the others; in No. 3 each of the radials except the right posterior carries a costal and an axillary (Fig. 21 *b*, *c*). These conditions probably arose because the right posterior radial was the last to appear. No. 2 shows too that the radianal appears first in the radial midline, the posterior radial to the right of and slightly above it. In some of the stages which follow (Nos. 3 and 5–7) the suture between the posterior and right posterior orals—which is the axis of the right posterior ray—lies to the right of the suture between the corresponding basal plates. This, it is probable, is because the right posterior radial of each first appeared to the right of the radial midline; it comes to occupy the true radial position later.

Similarly, in three of the younger pentacrinoids of *Notocrinus virilis* (Nos. 3, 6 and 7) the axis of the right posterior ray lies to the right of that of the suture between the posterior and right posterior basals.

Pentacrinoid larvae of **Promachocrinus kerguelensis** Carpenter

A. H. Clark (1921, pp. 530–57, figs. 881–937) has described a series of forty-three pentacrinoids of *Promachocrinus kerguelensis*, the youngest without any radial structures, the oldest with large and prominent interradial plates and three whorls of cirri on the proximal columnal.

There is in the present collection a pentacrinoid from South Georgia (St. 27, 110 m.) with interradial structures which is certainly *P. kerguelensis*; there are two younger pentacrinoids, one from the South Sandwich Islands the other from the Bransfield Strait region, which I believe to belong to this species. All three were taken in March.

No other crinoid but *P. kerguelensis* is known from the South Sandwich Islands, though others may well occur. The pentacrinoid from there (St. 366, 77–152 m.) is the youngest of the three. It resembles Clark's No. 33 (pp. 546–7, figs. 922–3). The crown is 1·3 mm. long. The stem is incomplete, of 23 columnals, the longest of which are four to five times as long as broad. The radials are just in contact. The only complete arm is of two brachials. I see no side-plates or sacculi.

The pentacrinoid from the Bransfield Strait region (St. 177, 1080 m.) resembles, so far as the shape and proportions of the radianal, radial and basal plates are concerned the specimen shown in Clark's fig. 90 (p. 545). But it is older and larger: the crown is 1·8 mm. long; the stem, of 26–30 columnals and a terminal plate, is nearly 7 mm. long. The arms are of three to six brachials.

The South Georgia pentacrinoid closely resembles the oldest of Clark's series, his pentacrinoid No. 43 (pp. 551–3). The crown is 9 mm. long but the arms are not complete. Only 12 columnals remain.

The centrodorsal is as high as it is broad and truncated distally. It has four whorls of cirrus sockets. Those of the most apical whorl are radial in position, the next are interradial, and so on. The cirri of the lower interradial row are the longest, being of 15 segments and reaching to about the fifth brachial. Those of the more apical radial whorl are shorter and of fewer, 11–12, segments but they are more mature in appearance. Both rows of cirri are in general similar to those described by Clark. The next, interradial, row are of 12–15 segments and reach to the first or second brachial but they are of immature form. The peripheral, radially situated, cirri are mere rudiments.

The columnal next to the centrodorsal is short, about three times as broad distally as it is long. Its width is equal to that of the base of the centrodorsal, greater than that of its truncated tip. It is wider distally than proximally for the distal half is raised into five forwardly projecting rounded lobes which are in contact only on the distal edge of the columnal. They perhaps represent the beginnings of the five plates that Clark describes as arising from the corresponding columnal of his pentacrinoid No. 43; but they are in the distal half of the columnal whereas Clark's arose from the proximal edge. Two narrower discoidal columnals follow and they are succeeded by a still narrower columnal which is half as long as broad. The remaining columnals are elongated.

Short basals are visible.

The radial radials approach the adult form. The interradial radials are much narrower but they reach nearly as far forward. Each carries a small costal and axillary, small oblong plates, the latter reaching nearly as far forward as the radial axillaries; there are no brachials on the interradial rays.

The radial arms are long and well developed but none is complete; the longest remaining is of about 20 brachials. They resemble those of Clark's specimen but I cannot see side-plates; it is certain that there are not large conspicuous plates such as Clark describes. This is interesting: the specimen comes from South Georgia where few adults have side-plates and those that do possess them have but few and small and scattered plates; Clark's specimen came from near Gaussberg, and it has been shown (pp. 143–4) that adults from such high latitudes have on the whole more and better developed side-plates.

From the eleventh brachial onwards there are long but incomplete pinnules. P_1, P_a and P_2 are also present but very small, of 1–3 segments.

Large triangular oral plates are present near the mouth.

The posterior interradius is damaged and too broken to show if the radianal plate remains.

Pentacrinoid larvae of **Isometra hordea** n.sp.

There are fifteen pentacrinoid larvae from St. 170 (23. ii. 27. Off Cape Bowles, Clarence Island, 61° 25′ 30″ S, 53° 46′ W, 342 m.) which form a series. The youngest is a prebrachial or cystid stage; the oldest has three whorls of cirri on the topmost columnal of its stem, and arms of about thirty brachials.

From the same station there are eighteen pentacrinoids of *Notocrinus virilis* which are described hereafter (p. 210).

The adult crinoids taken at this station were:

Promachocrinus kerguelensis	6
Isometra hordea	3
Notocrinus virilis	17
N. mortenseni	2

It does not follow that the pentacrinoids of the present series belong to any one of these species but it is probable that they do. I believe them to be *Isometra hordea*. They are not of *Promachocrinus kerguelensis*, the stages of which are known (see above). They do not closely resemble the pentacrinoids of *Notocrinus virilis* as one would expect those of *N. mortenseni* to do. On the other hand, they do appear to show some resemblances to *Isometra hordea*.

The shapes and proportions of the primibrachs and brachials of the oldest larvae and of *I. hordea* are similar. The distal brachials of the oldest pentacrinoid have a slight zigzag character suggestive of that of the middle part of the arms of *I. hordea*. The pinnule ambulacra are lined by side-plates and the tentacles have numerous spicules, the former not unlike, the latter resembling, those of *I. hordea*.

1. This is the only specimen of a cystid or prebrachial stage (Fig. 21 *a*).

The crown is 0·9 mm. long. The column is of 26 segments and 3·4 mm. long. The distal part of the column is narrower than the proximal. The first four or five columnals are very short and discoidal, much shorter than wide, but increasing in length. The middle columnals are nearly as long as wide, the distal are slightly longer. All are considerably wider medianly, where they are encircled by a narrow girdle, than at either end; they are evenly rounded off towards each end. The terminal plate is thick and rounded.

The base of the basal cup is considerably wider than the topmost columnals. The sides are faintly convex. The height of the cup is about two-thirds of the distal width. The orals form a cup slightly higher than the basals. The lateral edges of the orals are strongly bent outwards to give a high double ridge along each of the sutures between them. When the crown is seen with these ridges in profile the oral cup has more strongly convex sides than the basal.

2. In this stage the five radials and the radianal plate are present (Fig. 21 *b*). The crown is about 1 mm. long, the column 5·8 mm.

The column consists of 28 columnals and a terminal plate. The first six columnals are of roughly equal lengths, short and discoidal. The remainder are somewhat barrel-shaped; each is encircled by a narrow median girdle and, with the exception of a small number following the discoidal columnals and a small number at the distal end, is slightly longer than broad. The articular faces of the longer columnals are broadly oval, the long axes of those of the two ends of one columnal being at right-angles to one another. The long axes of the opposing faces of two contiguous columns coincide. For these reasons the alternate articulations of a part of the column appear, from some angles, to be of different kinds. The terminal plate is thick and rounded.

The base of the basal cup is not wider than the proximal columnals. Its height is equal to that of the oral cup; it is considerably less than its distal diameter. The lateral edges of the oral plates are more strongly bent outwards, especially proximally where a furrow lies between those of adjacent plates, than in the pre-brachial stage.

A small rounded radial plate is present in each of the angles between the basals and the orals. To the left of and a little below one of them which is smaller than the others is a slightly smaller plate, the radianal. In this radius the suture between the basals and that between the orals are not in line with one another as in other radii: the former is slightly to the left of the latter with the anal plate lying directly in line with it; the radial is in line with the suture between the orals.

3. Length of crown 1·0 mm. (Fig. 21 *c*); length of column 5 mm.

The column consists of 25 segments and a terminal plate and is similar to, though shorter than, that of the previous stage. Most of the columnals are encircled by a strong median girdle. The terminal plate is small, round and simple.

The basal cup is about two-thirds as long as its distal diameter. Its base is not wider than the proximal columnals; its sides are only slightly convex. The oral cup is a little longer than the basal. The radials are very much bigger than in the previous stage; the corners of the basals are cut away to receive them. The right posterior radial is strongly asymmetrical being undeveloped on the left side where the much smaller radianal plate lies. The right distal angle of the posterior basal is strongly cut away to accommodate the radianal plate. Each of the radials except the right posterior bears a small costal, and a smaller axillary; they lie in the furrow between the strongly turned out lateral edges of the oral plates but are massive enough to project beyond the edges of them in profile. The right posterior radial bears no ossicles.

The suture between the posterior and the right posterior basals and that between the corresponding orals are only a little out of line with one another.

4. Length of crown 1·0 mm.; length of column 4·6 mm.

The column is of 27 segments and a terminal plate and is similar to that of the previous stage. The first seven columnals are short and discoidal; the second is slightly longer and wider than the others which are of equal size. The terminal plate is thick and circular.

The proximal edges of the basal plates are slightly rounded. The base of the basal cup is wider than the proximal columnals. It is shorter than its distal diameter and shorter than the oral cup and its sides are nearly straight. The radials are slightly smaller than in the previous stage. The radianal is similarly placed. Each of the radials, including the asymmetrical right posterior, bears a costal and an axillary smaller than those of the previous stage.

There is a strong contrast between the nearly straight-sided basal cup and the oral cup which has a broadly-rounded dome-like profile because of the strongly everted edges of its plates.

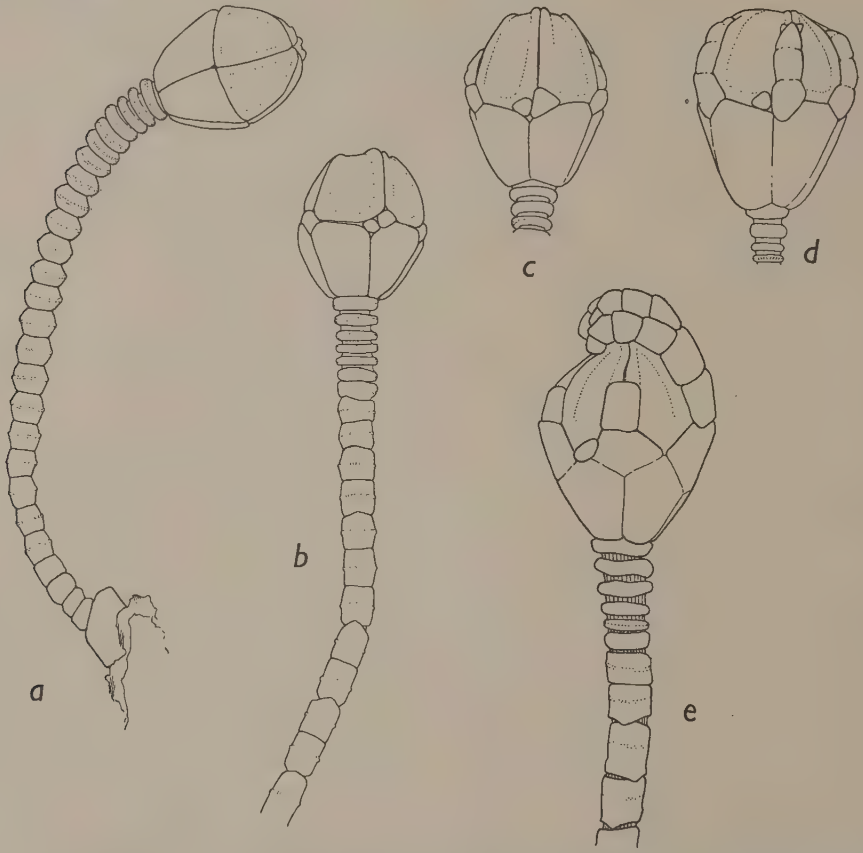

Fig. 21. Pentacrinoid larvae of *Isometra hordea*. *a*, crown and column of No. 1. *b*, crown and part of column of No. 2. *c*, crown and proximal columnals of No. 3. *d*, same of No. 5. *e*, same of No. 8. All ×26.

5. Length of crown 1·2 mm. (Fig. 21 *d*); length of column 5·4 mm.

The column is of 28 segments and similar to that of the previous stage; as in that stage the second of the proximal discoidal segments is larger than the others, which are of equal size. The terminal plate is large and irregular.

The sides of the basal cup are only very slightly convex. Its base is of the same width as the proximal columnal with which it is closely associated. It is about two-thirds as long as its diameter at the basi-oral suture, a little longer than the oral cup. The lateral edges of the orals are still more strongly everted than in the previous stages; the radials are considerably, the costals and axillaries very much, larger. The axillary is as large as the costal and carries two very small first brachials.

The radianal causes the posterior basal and the right posterior radial to be asymmetrical. The suture between the posterior and the right posterior basal plates is out of line with, to the left of, that between the corresponding oral plates; the axis of the ray coincides with the latter.

6. Length of crown 1·3 mm.; length of column 6·7 mm.

The column is of 33 segments. The first is very short and closely in contact with the basal cup. The next five are short and discoidal and become progressively and gradually smaller: that is, the second is slightly longer and wider than the third, and so on. The remaining columnals are similar to those of the stages already described: all but two or three following the discoidal proximal segments and three or four near the terminal plate are longer than broad, somewhat barrel-shaped, each with a narrow projecting girdle; the articular faces are broadly oval and the long axes of the two faces of each columnal are at right angles to one another. The terminal plate is simple.

The base of the basal cup is a little wider than the topmost columnal. Its distal diameter is nearly twice its length; its sides are nearly straight.

The proximal portions of the lateral edges of the orals are widely separated by the well-developed radials, costals and axillaries against which they are turned up; the distal portions are in contact with one another. The radials are five-sided, about as long as broad; they do not meet one another. The posterior basal and the right posterior radial are made asymmetrical by the radianal; the axis of the right posterior ray is not in line with, but considerably to the right of, the suture between the posterior and right posterior basals. The radianal appears to override the posterior oral.

The costals and axillaries are strongly developed; the latter reach as high as the apex of the oral dome and each carries a pair of first brachials, and some a pair of second brachials, which reach farther.

This is the first stage in which the radial structures reach beyond the orals.

7. The crown is damaged, about 1·3 mm. long; length of column 7 mm.

The stem is of 26 columnals and a small thick terminal plate. The first five columnals are short; the first and second are wider than the third to fifth. The remaining columnals, except for two or three following the short proximal columnals and three or four before the terminal plate, are longer than broad, the longest being one and a half times as long as broad. In other ways they resemble those of the stages already described.

The basals and radials together form a straight-sided cup (as in the next stage, see Fig. 21*e*). The radials are pentagons with rounded angles; they do not meet. The right posterior radial is made asymmetrical by the radianal which rests closely against it, and the ray it bears lies to the right of the line of the suture between the posterior and right posterior basals. The radianal is nearly in contact with the left posterior radial; it rests on the posterior oral.

Some of the arms are broken; others are of three brachials curling in over the apices of the oral plates (which appear to be in contact).

8. Length of crown 1·4 mm. (Fig. 21 *e*); length of column 7·7 mm.

There are 31 columnals and a small thick round terminal plate. The first five columnals are short and discoidal. The first is as wide as the base of the basal cup, the second is as wide but a little longer, the third resembles the first; all three are a little irregular. The fourth and fifth are narrower, shorter and more regular. The remainder, but for three or four following the discoidal segments and three or four adjoining the terminal plate, are considerably longer than broad—nearly one and a half times as long as broad. They are in other ways similar to those of the earlier stages described in this series; the median girdle is very faint and does not project.

The sides of the basi-radial cup are nearly straight. The radials almost meet in all interradii except the posterior where they are widely separated by the radianal. The radianal still causes a strong asymmetry in the right posterior radial; it is also in contact with the left posterior radial. It rests on the posterior oral. The anterior arms are of four brachials and curl in over the orals. No other ossicles than the costals remain on the posterior radials: that on the left is smaller than that on the right. The orals rest against the lower edges of the costals; they turn in under the axillaries and brachials and where the latter are lost it may be seen that the edges of the orals are in contact (Fig. 21 *e*). They are strongly everted.

9. Length of crown 2·7 mm. (Fig. 22 *a–c*); length of column 9 mm.

The stem is of 30 columnals and a round and simple terminal plate. The first five segments are short and irregularly discoidal. The first three are wider and slightly longer than the fourth and fifth. The sixth is longer, but broader than long; the seventh is almost as long as broad, the eighth longer than broad. The ninth to about the sixteenth are considerably longer, nearly twice as long as broad. The remainder gradually decrease in length, the last two or three being shorter than broad. Most of the longer segments have a very faint median girdle which does not project.

The sides of the basi-radial cup are straight. The radials, with the exception of the posterior pair, are in broad contact with one another. The posterior are separated by the radianal which lies in the midline of the posterior interradius, in contact with both radials and making each of them equally asymmetrical: whereas the other radials are seven-sided they each have six sides. The radianal rests on the posterior oral and extends as far forward as the distal edges of the radials. The orals, which are in contact with the inner distal edges of the radials, are broad plates with the lateral edges of the distal portion, which bends strongly in over the disk, strongly everted and in contact with one another.

The arms are of ten or eleven brachials. I can see no sacculi and side-plates along the ambulacra. There are no pinnules.

10. Length of crown 3·2 mm.; length of column 10 mm.

There are 34 columnals in the stem which is similar to that of No. 9. There are six short irregularly discoidal proximal columnals. The first is very short and closely attached to the basal cup. The second to fourth are wider and more robust than the first and fifth and sixth; the second is wider than the third and the third than the fourth. None of the columnals has a median girdle. The terminal plate is large.

The sides of the basi-radial cup are straight. All but the posterior radials are in broad contact. The proximal corners of the posterior radials meet, cutting off the radianal plate from contact with the basal for the first time; the distal portions of the posterior radials are separated by the radianal. Its centre lies to the right of the midline of the posterior interradius and it is in contact with the costal of the right posterior ray as well as with the two radials; its centre is in line with the articulation between the radial and the costal. Both the posterior radials are made asymmetrical by the radianal, the right far more so than the left, for its left distal corner is cut away to accommodate the radianal. The radianal overlaps the posterior oral.

The bases of the orals are in contact with the inner distal edges of the radials. They are flat plates with slightly out-turned edges which bend in over the disk, where their edges appear to meet, and are evenly rounded distally: they do not narrow to bar-like projections.

The costals and axillaries are considerably stouter than in the previous stage (No. 9). The arms are of 12 or 13 brachials. There are no pinnules and I can see no sacculi or side-plates along the arm ambulacra.

11. Length of crown 3·5 mm.; length of column 11 mm.

There are 36 columnals and a large lobed terminal plate. The first five columnals are short and irregular. The first and second are as wide as the base of the basal cup, the second a little longer than the first. The third and fourth are slightly, the fifth considerably, narrower. The remainder of the stem is similar to those of Nos. 9 and 10. None of the segments has a median girdle.

The sides of the basi-radial cup are straight. All the radials are in broad contact though that of the posterior radials is incomplete distally because of the radianal which lies in contact with both of them and the costals they bear. It is a nearly circular plate lying in the mid-line of the posterior interradius, its proximal edge opposite the articulations between the radials and the costals, its centre opposite a point a third of the way along the costals. Its contact is closer with the right than the left posterior ray. It lies much nearer to the outside than the oral.

The orals lie deep within the arms, their bases in contact with the inner distal edges of the radials, their lateral edges underneath the edges of the arms on either side. They bend in over the disk, gradually narrowing as they do so: their edges probably do not meet over the disk.

The costals, axillaries and brachials are considerably more robust than in No. 10. The arms are of about 14 brachials; the ninth and tenth brachials of some arms bear the beginnings of the first pinnules to be formed. I see no sacculi and no side plates along the arm ambulacra.

12. Length of crown 5·6 mm. (Fig. 22 *d*); length of column *ca.* 12 mm.

There are 36 columnals and a large lobed terminal plate. The first columnal is short and as wide as the base of the basal cup to which it is closely attached. It bears the beginnings of five radially situated cirri, each, except for the left posterior which is broken off, of about three to five segments. The proximal border of the second columnal is deeply notched radially opposite each of the developing cirri. The third to fifth columnals are as short as the first and second; they are irregularly discoidal. The sixth to eighth are longer, the ninth slightly longer than broad. The remainder of the stem is similar to that of No. 11; none of the columnals has a median girdle.

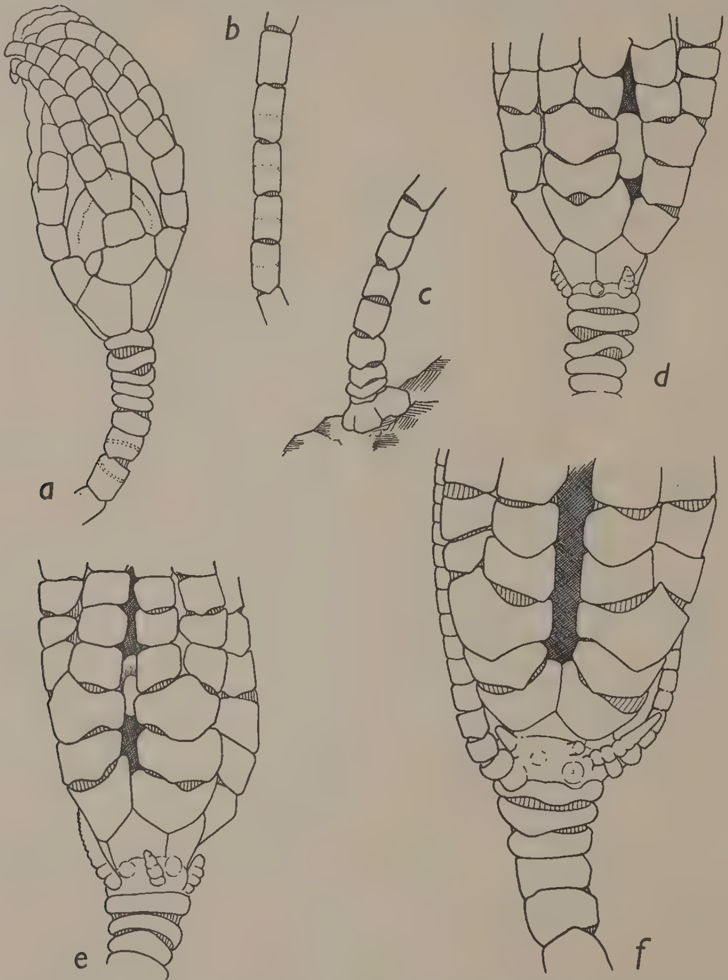

Fig. 22. Pentacrinoid larvae of *Isometra hordea*. *a*, crown and proximal columnals of No. 9. *b*, tenth to fourteenth columnals of No. 9. *c*, last columnals and terminal plate of No. 9. *d*, proximal portions of crown and column of No. 12. *e*, same of No. 14. *f*, same of No. 15. All ×18.

The radials are longer than the basals. They are all in broad and complete lateral contact. The right distal corner of the left posterior radial extends farther forwards than the contiguous corner of the right posterior radial; the radianal plate is in contact with the former but not with the latter. It is a long narrow plate lying between the posterior rays, just below the level of their edges. The oral plate can be seen deep within the arms behind it (but not in such a way as to be shown in the figure). The proximal border of the radianal plate is half-way along the costal, its distal border opposite the beginnings of the first brachials.

In two of the remaining interradii the arms are too closely pressed together for the oral plate to be seen. In each of the other two the oral is visible, its base opposite the middle of the axillary, i.e. for the first time out of contact with its radials, its distal portion sloping steeply inwards. I can see no plates in the perisome separating it from the radials.

The costals, axillaries and brachials are more massive than in the previous stage. The lateral edges of the axillaries are parallel. The arms are of about 20 brachials; from the ninth brachial onwards there are pinnules of up to eight segments. There are a few small irregularly arranged sacculi on some arms. There appear to be small side-plates along the arm ambulacra.

13. Length of crown 5·4 mm.; length of column 12 mm.

The column is of 34 columnals and a large lobed terminal plate. It is very similar to that of No. 12. The first columnal bears five slightly longer cirri, the longest as long as the side of a basal plate.

The crown is very similar to that of No. 12. The sides of the basi-radial cup are straight in the proximal basal portion, bulge slightly outwards in the radial portion. The right distal corner of the left posterior radial extends a little farther forward than the contiguous corner of the right posterior radial—not nearly so much so as in No. 12: the radianal is far removed from it. The proximal edge of the radianal plate is opposite a point half-way along the costal; the proximal edges of the orals are opposite the distal edges of the costals. There are a few sacculi and small side-plates along the arms.

14. Length of crown 6·8 mm. (Fig. 22 *e*); length of column 13 mm.

There are 35 columnals and a large lobed terminal plate. The first columnal is longer and more massive than in the previous stages. It bears two whorls of cirri, a radial whorl of five larger cirri arising from large sockets occupying nearly the entire length of the segment, and an interradial whorl of five very small cirri arising from the proximal half of the segment. The longest of the radial cirri consist of more than 12 segments and are longer than the basal plates. The second columnal is discoidal, of the same diameter as, but shorter than, the first; its proximal edge is not notched opposite the cirri of the first. The third is shorter and narrower than the second and irregularly discoidal. The fourth and fifth are still narrower but slightly longer. The remainder of the column resembles that of the stages described above.

The contiguous distal corners of the posterior radials are unequal as in Nos. 12 and 13. The radianal plate is more distant from them than in those younger specimens: its proximal edge is opposite a point a third of the way along the axillary; it extends to a third of the way along the first brachial. It is smaller than in specimen 13. It rests on the anal tube which ends opposite the distal half of the first brachial. The oral plate may be seen deep behind the end of the anal tube. In other interradii it may be seen that the other oral plates are pushed farther distally than in the younger specimens; their proximal edges are level with those of the first brachial.

The costals and axillaries are as wide as the radials and of the shapes shown in Fig. 20*e*. The arms are of 22–24 brachials with pinnules arising from the tenth and succeeding brachials. The longest pinnules are of ten or more segments. There are side-plates and a few sacculi along the arms.

15. Length of crown *ca.* 11 mm. (Fig. 22*f*).

This is a far bigger and older specimen than the last (No. 14).

The stem is of 32 columnals and a very large and lobed terminal plate. The first columnal is considerably longer than in No. 14, and tapers somewhat distally. It bears three whorls of cirri. The largest is a radial whorl arising from the distal half of the columnal, one in each radius; the longest are of 27 segments and extend as far as the seventh brachial. They terminate in claws and their penultimate segments carry small opposing spines. A whorl of much smaller cirri arises interradially from half-way along the columnal. There are five cirri in this whorl, one in each of three interradii, two in the fourth and none in the fifth which is contiguous with it. The beginnings of a third, radial, whorl arise from the proximal border of the columnal.

The second columnal is short and discoidal and slightly wider than the tapered end of the first; its proximal border is incised opposite each of the large radial cirri, so deeply opposite some cirri as to extend for the length of the segment and so cut its periphery into lobes. The third columnal is short and discoidal and very slightly narrower than the second. The fourth and fifth are irregular and narrower and longer. The remainder of the columnal is similar to the same parts of those of the stages already described.

The basal plates are very reduced; in the radial mid-line they appear to be less than one-sixth as long as the radials. The radials are long and in close contact with one another. The costals and axillaries are as wide as the radials. The arms are too closely pressed together for the oral plates or the radianal to be seen.

The arms are of about 30 brachials. Syzygies occur between brachials 3 + 4, 9 + 10 or 10 + 11, 13 + 14, 18 + 19. Long pinnules or 12 or more segments arise from the tenth and succeeding brachials. The beginnings of the first pinnules (P_1) are present on the second brachials.

There are fairly regularly arranged small dark sacculi along the arms and small side-plates along the arm ambulacra. There are small side-plates, one or two to each segment, along the pinnule ambulacra and numerous spicules in the tentacles. A few of the spicules are nearly smooth but most are strongly thorny and some are branched. The side-plates are not unlike, and the spicules resemble, those of adult *Isometra hordea*.

Pentacrinoid larvae of **Notocrinus virilis** Mortensen

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ W. 342 m. Gear DLH. Bottom: rock. Eighteen specimens (Nos. 1–7, 10–20).

St. 175. 2. iii. 27. Bransfield Strait. 63° 17′ 20″, 59° 48′ 15″ W. 200 m. Gear DLH. Bottom: mud, stones and gravel. Two specimens (Nos. 8 and 9).

That these twenty pentacrinoids from the Bransfield Strait region are of *N. virilis* is shown by the fact that they all carry in superficial pits in the orals, and sometimes in other adjacent ossicles, glandular sacs similar to those described from the posterior end of the embryos by Mortensen (1920) who has described the eggs and embryos of the species. One of the larvae (No. 7) occurred on a cirrus of an adult *N. virilis*. The last three of the series (Nos. 18–20) have small plates in the naked perisome which separates the oral plates from the radials: the perisome of adult *N. virilis* is strongly plated. The oldest larva has along the arm ambulacra strong side- and cover-plates of the same nature as those of *N. virilis*.

The series is not so complete as that of *Isometra hordea*. There is no prebrachial stage: the youngest larva has arms of two or three brachials. The oldest has only one whorl of cirri on the topmost columnal of its stem; its arms are of nineteen brachials.

The adult crinoids taken at St. 170 are shown on p. 202. Those at St. 175 were:

Promachocrinus kerguelensis	3
Phrixometra nutrix	1
Isometra vivipara	1
Notocrinus virilis	7

1. Length of crown *ca.* 1·4 mm. (Fig. 23 *a*); length of column *ca.* 6·4 mm.

The column is of 34 columnals and a thick roughly circular terminal plate which appears to be simple: I cannot see any supplementary plates like those known in the larva. The first seven columnals are short and discoidal. The most proximal is in close contact with the basal plates. From the second to the seventh there is a gradual decrease in width. The eighth is about one-third, the ninth about a half, as long as broad; the proximal half of each is encircled by a narrow projecting girdle. The remaining segments are about as long as broad except for five or six at the distal end which are shorter. They are rounded off to, and narrower at, each end than in the middle, where they are encircled by a narrow projecting girdle. They are somewhat barrel-shaped. The articular faces are very broadly oval, the long axes of those at the opposite end of each columnal at right angles to one another. The columnals are of a coarse texture like the ossicles of the crown.

The sides of the basal cup are strongly rounded. Its height is equal to about half its diameter at the distal end. The distal corners of the basal plates are deeply cut away to receive the radials. The crown is damaged on one side and one ray has been broken away: it must be the right posterior ray, for there is no sign of the radianal plate against any of the other radials. In three rays that are complete the arms are of two, or sometimes three, brachials. They curl in above the apices of the orals.

The surfaces of the lower part of the oral plates are only a little sunken below the level of those of the basals, the radials, the costals and the axillaries with which their edges are in contact. The texture of all the plates is coarse but that of the orals coarser than any; the surface of the proximal part of each is deeply pitted and some of the pits carry pale yellow spherical bodies which must be the glandular sacs known from the posterior end of the embryo (Mortensen, 1920, p. 52, pl. xxiv, fig. 2). In preparations of embryos slightly older than that figured by Mortensen I have seen the sacs lying close against the oral plates, and although they were not partly enclosed in their stereom it seemed that they might easily become so as growth went on.

Such sacs occur in all the older larvae to be described in this series. They are sometimes abundant and may occur in superficial pits in the surfaces of the basals, the radials, the costals and the axillaries as well as in the orals.

2. Length of crown 1·6 mm. (Fig. 23 *b*); length of column 6·7 mm.

The stem is of 36 columnals and similar to that of the previous stage. A larger number, about 12, of the distal columnals are shorter than broad and they are slightly wider than the other columnals; they become progressively wider as they approach the terminal plate. The terminal plate is simple, thick and slightly irregular.

The radials are widely separated from one another. The rays are bigger than in No. 1; the arms are of five brachials and extend well beyond the orals. The proximal edges of each oral rest against the basal, the radials and the costals of its interradius. Opposite the axillaries it narrows into a strap-like projection with slightly out-turned edges which curves in over the disk. The projections of the five orals do not enter into close contact. The orals are of very coarse texture. The surface of the proximal portion of each is pitted and some of the pits carry glandular sacs of diverse sizes. One or two of the radials and costals carry similar sacs. There is a single sacculus on one of the arms which has exactly the same appearance as the glandular sacs.

The radianal plate occupies an unusual position: its centre lies to the left, not right, of the mid-line of the posterior interradius and it lies close against, and causes asymmetry in, the left, not the right, posterior radial. The corner of the right posterior radial is just in contact with it. The distal half of the radianal rests upon the posterior oral.

3. Length of crown 1·9 mm. (Fig. 23 *c*); length of column 8 mm.

The stem is of 39 columnals and a terminal plate which is large and lobed but does not appear to be composed of more than one element. The column is generally similar to that of the younger stages but there are slight differences: the discoidal proximal segments, of which there are nine, are even shorter, whereas the majority of the middle segments are slightly longer, being a little longer than broad.

The radials are widely separated. Three of the rays are stronger than in the previous stage, the arms of about six brachials. The anterior and the left anterior rays are small, bearing only the first brachials; they are shorter than the orals. The lateral edges of the orals become free opposite the costals, beyond which the plates rapidly narrow to inwardly curved strap-like ends. Some of the orals are in contact with the basal plates of their interradius, others separated from it by a very narrow strip of perisome. A wide area of perisome separates the posterior oral from its basal. On it lies the radianal plate with its distal end overlapping the oral.

The centre of the radianal plate lies to the right of the mid-line of the posterior interradius but it is not in contact with the right posterior radial, which, nevertheless, is strongly asymmetrical. The axis of its ray lies far to the right of the suture between the posterior and right posterior basals. The proximal left-hand corner of the radianal touches the left posterior radial.

Strong side-plates are developed along the ambulacra of the arms.

4. Length of crown 2·1 mm.; length of column 7 mm.

The stem is of 41 columnals and a thick lobed terminal plate which appears to be simple; it is generally similar to that of the previous stage. There are ten very short discoidal proximal columnals, those nearer the basal cup wider than the others. Most of the remaining columnals in the first half of the stem are nearly as long as broad but those of the distal half become progressively and gradually shorter towards the terminal plate.

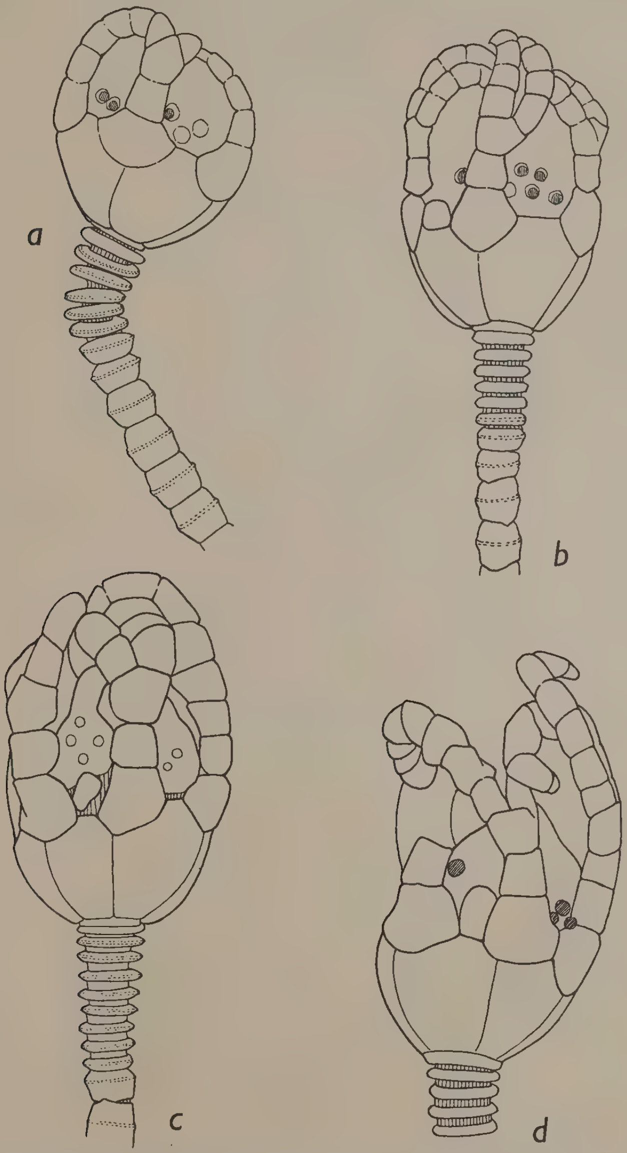

Fig. 23. Pentacrinoid larvae of *Notocrinus virilis*. *a*, crown and proximal columnals of No. 1. *b*, same of No. 2. *c*, same of No. 3. *d*, same of No. 6. All ×27.

The basal cup has strongly rounded sides. The radials are widely separated from one another. The arms of only two rays are complete; they are of five brachials. The radianal plate is in broad contact with the right posterior radial which it makes asymmetrical; it is in contact with the proximal half of the left posterior radial. It overrides the oral; no naked perisome is to be seen in this interradius. In other interradii the orals may be separated from the basals by a narrow strip of perisome.

The edges of the orals become free opposite the costals, beyond which the plates narrow as they turn in over the disk.

There are side-plates along the ambulacra of the arms.

5. Length of crown 1·9 mm.; length of column 9 mm.

The column is generally similar to that of previous stages. There are 43 columnals and a round terminal plate which appears to be simple. The first seven columnals are short and discoidal and become progressively more narrow from the first to the seventh. The tenth to about the twentieth are about as long as broad, the remainder broader than long.

The crown is smaller than in the previous stage and the basal cup is not so strongly rounded. Some of the radials are widely separated, others less so, and one pair, the right posterior and the right anterior, are in contact. The centre of the radianal plate is to the right of the mid-line of the posterior interradius; it is in broad contact with the right posterior radial which it makes asymmetrical. It is in less complete contact with the left posterior radial.

None of the orals is separated from the more proximal ossicles of its interradius by naked perisome. They are shaped as in the previous stage.

The arms are of about six brachials.

6. Length of crown 2 mm. (Fig. 23 *d*); length of column 9 mm.

The stem is similar to that of the previous stage. There are 42 columnals and a large, rather thin and slightly lobed, terminal plate which does appear to be made up of more than one element.

The sides of the basal cup are strongly rounded; its height is about half its distal diameter. The radials, except for the right and left posterior, are nearly or quite in lateral contact. By their lateral growth they have pushed the orals out of contact with the basals; where they are not quite in contact small naked areas of perisome separate them from one another. The right and left posterior radials are separated by the radianal plate which lies in broad contact with the former and in contact with the proximal third of the latter. It causes the right posterior radial to be asymmetrical and the longitudinal axis of its ray lies far to the right of the suture between the basals on which it rests. The radianal plate rests on the oral.

The lateral edges of the orals become free opposite the end of the costals; beyond that point they narrow and bend in over the disk. They are of the usual coarse texture, deeply pitted proximally with some of the pits carrying glandular sacs.

The left posterior ray is broken off at the costal. The arms of the other rays are of about eight brachials. There are a few small sacculi of the same appearance as the glandular sacs. The arm ambulacra are lined by large side-plates.

7. Length of crown 2·2 mm.; length of column 10 mm.

There are 45 columnals and a large faintly lobate terminal plate which is single. The first eight columnals are short and discoidal, of roughly equal length but gradually decreasing in diameter from the first to the sixth. The remainder of the column resembles those of previously described stages.

The radials are widely separated. The radianal is in contact with the right posterior but not the left posterior radial. Its proximal half lies on the naked perisome which separates the posterior basal from the oral; its distal half lies on the oral. The orals of the other interradii are separated from their basals by very narrow strips of perisome. They are shaped as in previous stages and are richly supplied with glandular sacs: there are as many as eight on one plate.

Three of the rays have arms of eight brachials. The costals and axillaries of the right posterior ray are smaller than those of others and its arms are of no more than three or four brachials; the right anterior ray has equally short arms but they appear to be broken, not undeveloped.

The right posterior radial is made asymmetrical by the radianal, and the whole of the ray, but for a corner of the radial itself, lies to the right of the line of the suture between the basals upon which it rests.

There are a few irregularly placed sacculi, of a similar appearance to the glandular sacs, along the arms, and strong side-plates along the ambulacra.

8. Length of crown 2·4 mm.; the column is incomplete.

Only 13 columnals remain. The first five are short and discoidal but longer than those of previous stages. The sixth is about half as long as wide, the remainder about as long as wide; they are encircled by a narrow projecting girdle which is in the proximal half of the sixth columnal but median in all the others.

The crown is very similar to that of the previous stage except that: the radianal plate lies entirely to the right of the mid-line of the posterior interradius; all the arms are of equal size, of about six brachials; the basals and one of the radials—as well as the orals—carry many glandular sacs in pits.

9. Length of crown 3 mm. (Fig. 24 *a*); the column is incomplete.

Only 29 columnals remain. The first is short and closely associated with the basal cup. The second to fifth are short and discoidal. The sixth is discoidal but longer. The seventh is about half as long as broad. The eighth to near the twentieth are as long as broad, the remainder slightly broader than long.

The crown is similar to, though larger than, those of the two previous stages. Each of the basal plates is swollen so that the sutures between them run along depressions. The distal half of the radianal plate lies, not on the oral, but on a lobe of tissue at a higher level than, and overlapping the proximal edge of, the oral plate. I assume it to be the beginnings of the anal tube.

As in the previous stage from the same station (St. 175) there are glandular sacs on other ossicles than the orals.

The arms are of seven or more brachials.

There are five specimens of roughly the same age as those described as numbers 3 to 9 above, though for the most part they are slightly larger. They do not call for individual description. The terminal plate appears to be single in all, though it is difficult to be certain that it is. The longest columnals of the stem of one or two are longer than any yet described. In some the orals are in contact with the basals, in others separated from them by narrow strips of perisome. Most of the radials are nearly in contact with one another in all. In none of the specimens does the anal tube show behind the radianal plate as in number 9.

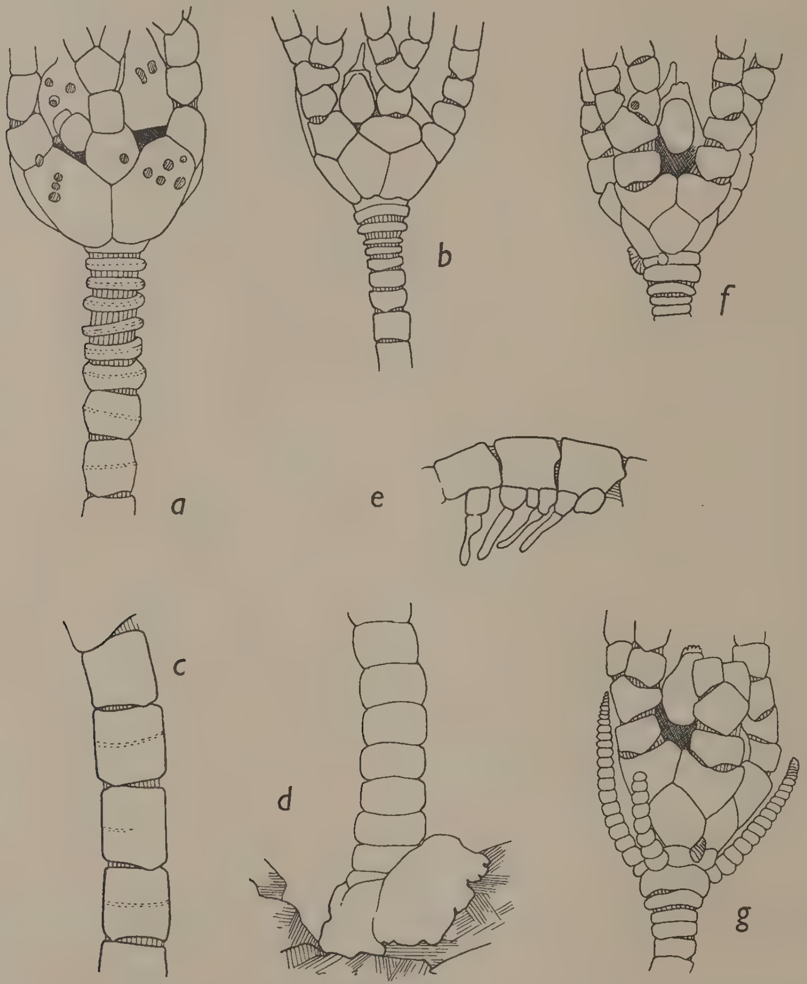

Fig. 24. Pentacrinoid larvae of *Notocrinus virilis*. *a*, proximal portions of crown and column of No. 9, ×18. *b*, same of No. 15, ×14. *c*, tenth to thirteenth columnals of No. 15, ×26. *d*, last columnals and terminal plate of No. 15, ×26. *e*, a few brachials of No. 15 showing size of side- and cover-plates, ×26. *f*, proximal portions of crown and column of No. 18, ×14. *g*, same of No. 20, ×14.

The measurements of the specimens and the number of columnals in the stem and of brachials in the arms are as follows:

10. Crown 2·9 mm.; stem: 39 columnals, 9·6 mm.; arms of about 8 brachials.
11. Crown 2·5 mm.; stem: 43 columnals, 10 mm.; arms of about 8 brachials.
12. Crown 2·5 mm.; stem: 34 columnals, 11 mm.; arms of 8–10 brachials.
13. Crown 2·9 mm.; stem: 39 columnals, 10 mm.; arms of 8–10 brachials.
14. Crown 2·7 mm.; stem: 44 columnals, 10·4 mm.; arms of 10 brachials.

The next specimen is considerably older than any of the preceding:

15. Length of crown 4 mm. (Fig. 24 *b–e*); length of column 10·5 mm.

The stem is of 39 columnals and a thick slightly lobed terminal plate. The first columnal is incomplete so that the second, although for the most part in touch with it, is in touch with the basal cup too; it is not shown in the figure, in which the most proximal columnal is the second. The second to seventh columnals are short. The third is narrower than the second. The fourth to seventh are of the same diameter as one another, narrower than the third. There is a gradual increase in length from the fourth to the seventh columnal, the seventh being half as long as wide. The tenth is as long as broad; the eleventh to the fourteenth are slightly longer than broad (Fig. 24 *c*). The remaining columnals gradually decrease in length: the most distal are wider than long (Fig. 24 *d*). Only faint traces of the encircling girdles of the columnals remain. The articulating surfaces of the two ends of each columnal, or at least of the longer columnals, are broadly oval with the longer axis of one end at right angles to that of the other; this is only just perceptible.

The sides of the basi-radial cup are nearly straight; its height is about half its distal diameter. The basals are considerably longer than the radials. The radials, except for the posterior pair, are in broad contact with one another; beyond the parts of the lateral edges which are in contact they narrow a little. The middle of the wide distal edge is indented for the articulation of the costal; it occupies about a half of the distal edge of the radial. The lateral edges of the posterior radials meet proximally, but are cut away beyond to allow room for the radianal plate: it follows that both the radials are asymmetrical, and they are equally so.

The radianal plate is diamond-shaped and longer than broad. Its proximal half is in contact with the radials and costals; the distal half lies on the anal tube which is much wider than it and has gently converging lateral edges and a straight distal margin. It is very near the edge of the disk: the level of the radianal plate is only a little below that of the radials.

The narrow end of the posterior oral may be seen beyond the anal tube, far below its level, curving over the disk (Fig. 24 *b*). The other oral plates bend sharply in over the disk and rapidly narrow in their distal halves; they are separated from the radials by a narrow naked strip of perisome. The surface of the wider proximal part of each oral is pitted and some of the pits carry glandular sacs.

The arms are of 15–16 brachials with large side- and long cover-plates (Fig. 24 *e*) and irregularly arranged sacculi. On the distal portions of some arms there is one sacculus to each segment. The rudiments of pinnules arise from the eleventh and succeeding brachials.

16. Length of crown 3·5 mm.; length of column 11 mm.

The column is similar to that of No. 15. There are 40 columnals and a damaged terminal plate.

The crown is similar to that of No. 15. The radials are longer, being only slightly shorter than the basals; the dorsal surface of each is strongly rounded. The posterior radials are in contact for more than half their length, beyond which they are cut away to accommodate the proximal part of the radianal. The other radials are in complete lateral contact. The radianal plate rests on the anal tube, completely covering it. There is no naked perisome in the posterior interradius, and the orals of other interradii are either in contact with the radials or separated from them by an extremely narrow strip of perisome.

17. Length of crown 5 mm.; length of column 9 mm.

There are 37 columnals and a large lobed terminal plate. The first columnal is short and it bears the rudiment of a cirrus in each of the radii except the right posterior. The remainder of the column resembles that of earlier stages; each segment is encircled by a faint but distinct median girdle.

The crown is generally similar to, though smaller than, those of Nos. 15 and 16. The radials, including the posterior pair, are in complete lateral contact. The dorsal surfaces of the ossicles of the division series and of the brachials are strongly rounded. The arms are of seventeen brachials of which the tenth and succeeding carry pinnules.

18. Length of crown 5 mm. (Fig. 24 *f*).

The stem is of 40 columnals and a large lobed terminal plate. The first columnal is short and it bears the rudiment of a cirrus in the anterior, the left anterior, and the left posterior radii. The second columnal is as wide as the first and longer. The third to fifth are narrower and discoidal. The remainder of the column resembles those of younger stages.

The basal plates are slightly longer than the radials. The radials are in complete lateral contact. The radianal plate is far out of contact with the posterior radials, being separated from them by naked perisome; its proximal edge is opposite the distal end of the costals. It is an oval plate resting on the anal tube which extends some way beyond it—to opposite the end of the first brachial. The posterior oral plate is clearly visible behind the anal tube. The proximal borders of the orals of other interradii are opposite a point half way along the axillaries so that they are widely separated from the radials by an area of perisome; a number of plates are present in it. The oral plates are of coarse texture with their proximal surfaces pitted as in younger specimens. The distal end of each narrows to a bar which bends in over the disk.

The rays resemble those of No. 17. A few large sacculi occur at irregular intervals along the arms.

19. Length of crown 8 mm.; length of column 13 mm.

There are 41 columnals and a large terminal plate which is damaged. The first columnal is much bigger than in any of the younger stages: it is more than one-third as long as broad. Long cirri of about 15 segments, which reach the ends of the radials, arise from it in all radii but the posterior in which there is only the beginning of a cirrus, about one-quarter the length of the basal plates. The second segment is as wide as the first but it is short. The third and fourth are narrower and they are discoidal. The column is otherwise similar to those of younger stages.

The basals are longer in proportion to the radials than in No. 18. In other ways the crown resembles that of No. 18. The only complete arm is of 22 brachials with pinnules arising from the eleventh and succeeding brachials. There are very strong side- and cover-plates along the arm and pinnule ambulacra and a few irregularly arranged sacculi along the arms.

20. Length of crown 9 mm. (Fig. 24 *g*); length of column 13 mm.

The stem is of 38 columnals and a large lobed terminal plate. The first columnal is not so big as in No. 19 but its cirri, of which there is a single radial whorl, are longer though they are of unequal lengths. The anterior and left anterior are of about 22 segments and reach to the first brachial; the right anterior is somewhat shorter; the left posterior is broken; the right posterior is a rudiment one-third as long as the basal plate. The cirri arise from sockets which incise the columnal for its entire length. The second columnal is as wide as, and longer than, the first. There are indentations in both its proximal and distal margins opposite the larger cirri of the first columnal. The remainder of the column resembles that of slightly younger specimens. The columnals of the middle part of the stem are each encircled by a narrow median girdle.

The crown resembles those of Nos. 18 and 19. A glandular sac occurs in a pit in the surface of one of the axillaries as well as in the orals.

The arms are of 19 brachials. Pinnules of up to nine or ten segments occur on the ninth and succeeding brachials; the lower pinnules are not yet beginning to form. There are strong side- and cover-plates, of the same nature as those of the adult *Notocrinus virilis* along the ambulacra. There are a few irregularly arranged sacculi along the arms.

ANTARCTIC COMATULIDS PREVIOUSLY IN THE BRITISH MUSEUM COLLECTION

From the National Antarctic ('Discovery') Expedition, 1901–4

Promachocrinus kerguelensis		
Off Coulman Island	100 fathoms	4 specimens
Winter Quarters		1 ,,
,,	No. 10 Hole	4 ,,
East end of Barrier	100 fathoms	1 ,,
Mount Erebus and Terror	500 ,,	1 ,,
Anthometra adriani		
Winter Quarters	124 fathoms	2 ,,
,,	130 ,,	2 ,,
,,	No. 10 Hole	3 ,,
Mount Erebus and Terror	500 fathoms	6 ,,
Florometra mawsoni		
Winter Quarters	178 fathoms	1 ,,
Mount Erebus and Terror		2 ,,

From the British Antarctic ('Terra Nova') Expedition, 1910

The localities are all in the Ross Sea. Their positions are given in Harmer and Lillie, 1914, List of Collecting Stations, Natural History Report, Vol. II, No. 1 of the Expedition's series of reports.

Promachocrinus kerguelensis			
St. 194	2 specimens	St. 340	4 specimens
St. 294	3 ,,	St. 341	1 ,,
St. 314	1 ,,	St. 349	9 ,,
St. 316	1 ,,	St. 355	6 ,,
St. 317	2 ,,	St. 356	1 ,,
St. 339	5 ,,		
Anthometra adriani			
St. 194	1 specimen	St. 316	5 specimens
St. 225	1 ,,	Off Barne Glacier	1 ,,
St. 314	3 ,,		
Florometra mawsoni			
St. 314	4 specimens	St. 316	1 specimen
Notocrinus virilis			
St. 295	2 specimens	St. 314	fragments
St. 341	1 ,,		

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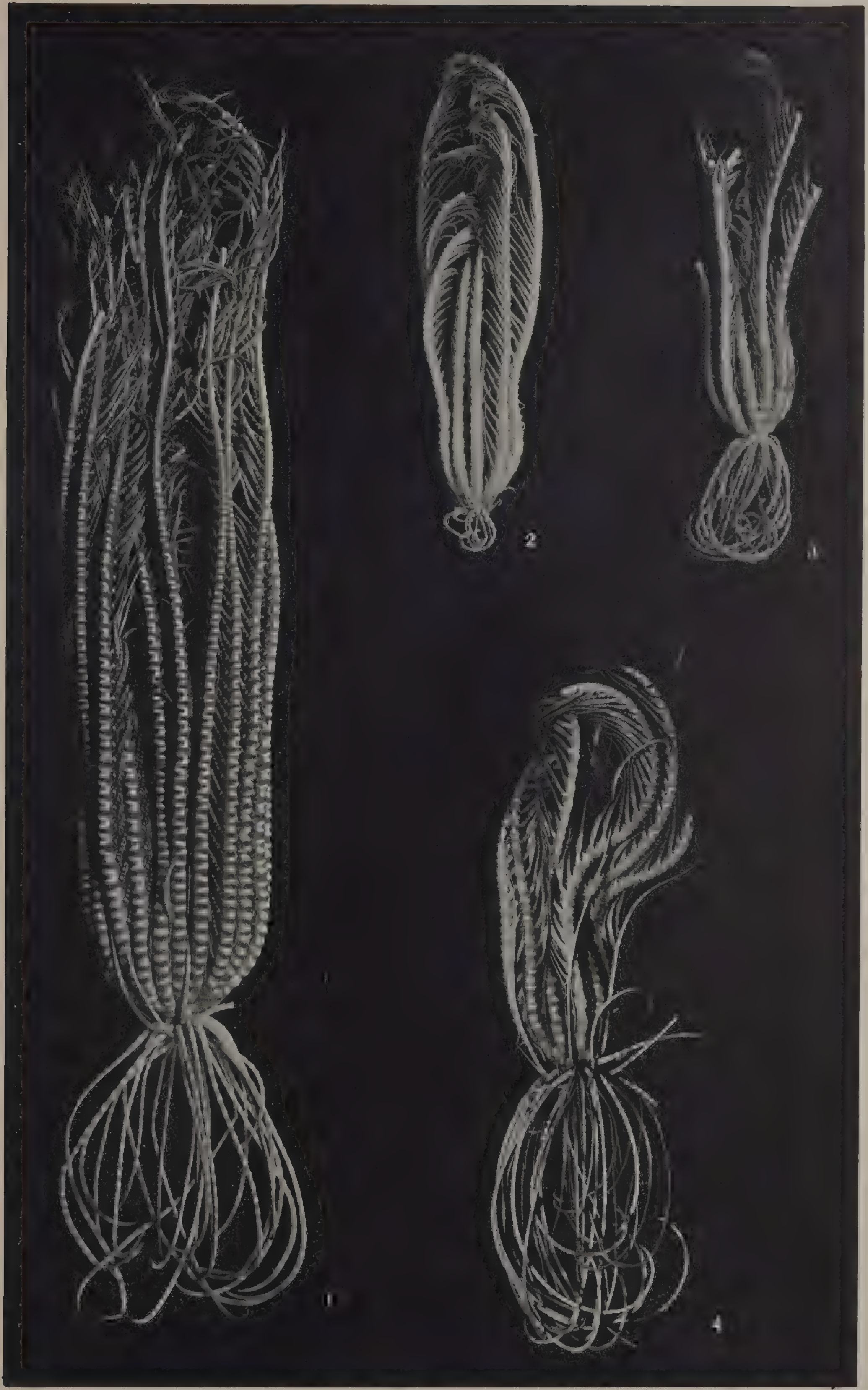
PLATE III

Fig. 1. *Promachocrinus kerguelensis.*
Fig. 2. *Florometra mawsoni.*
Fig. 3. *Florometra antarctica.*
Fig. 4. *Anthometra adriani.*

All figures natural size.



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CRINOIDEA

PLATE IV

Fig. 1. *Eumorphometra aurora*, × 2.
Fig. 2. *Eumorphometra fraseri*, × 2.
Fig. 3. *Eumorphometra marri*, × 2.
Fig. 4. *Kempometra grisea*, × 2.
Fig. 5. *Phrixometra longipinna* var. *antarctica*, St. 1948, × 4.
Fig. 6. *Phrixometra longipinna* var. *antarctica*, St. 156, × 4.
Fig. 7. *Phrixometra nutrix*, × 4.
Fig. 8. *Phrixometra rayneri*, × 4.

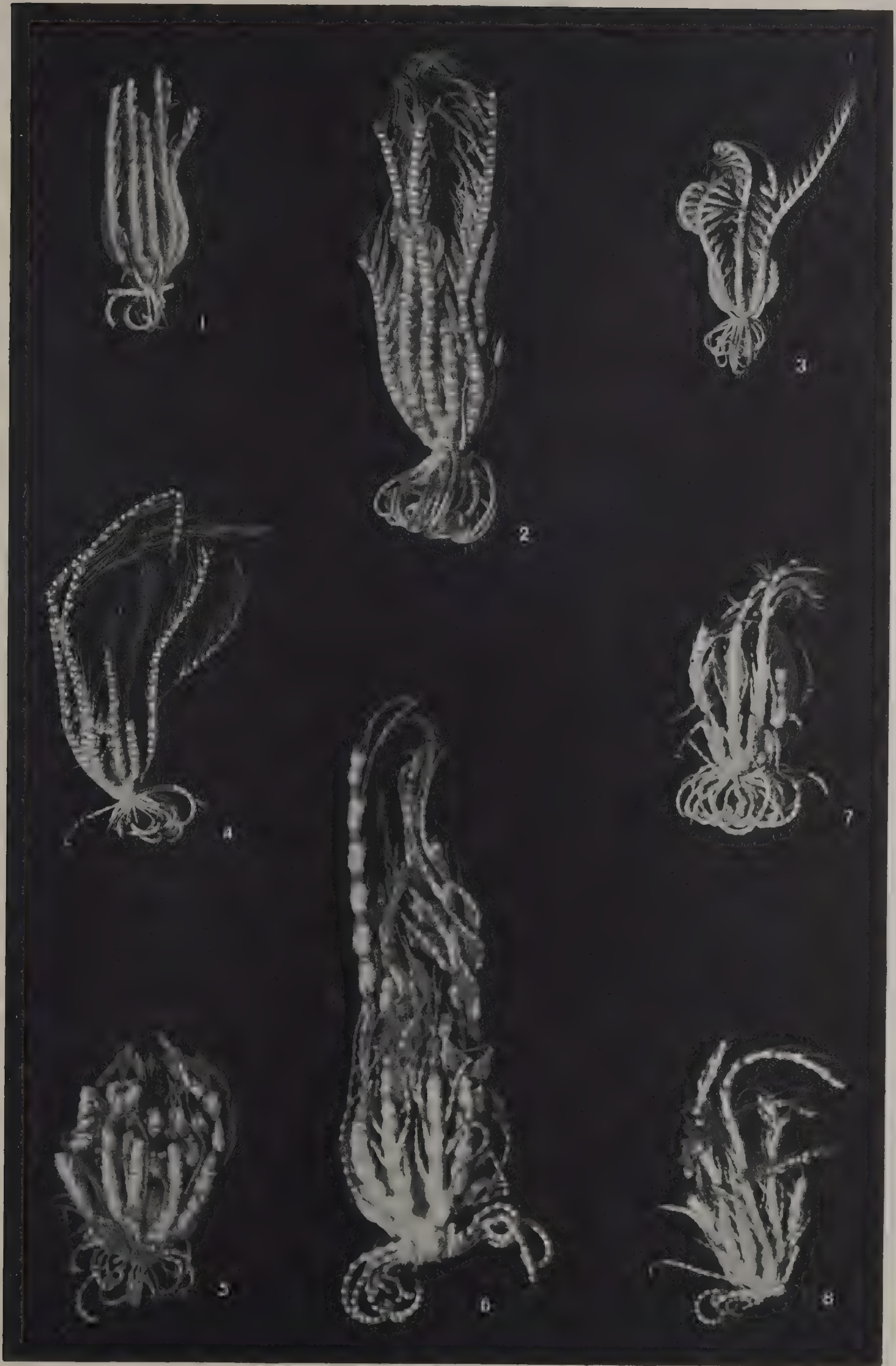

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PLATE V

Fig. 1. *Isometra vivipara*, ♂.
Fig. 2. *Isometra vivipara*, ♀.
Fig. 3. *Isometra flavescens*, ♂.
Fig. 4. *Isometra flavescens*, ♀.
Fig. 5. *Isometra graminea*, ♂.
Fig. 6. *Isometra graminea*, ♀.
Fig. 7. *Isometra hordea*, ♂.
Fig. 8. *Isometra hordea*, ♀.

All figures natural size.

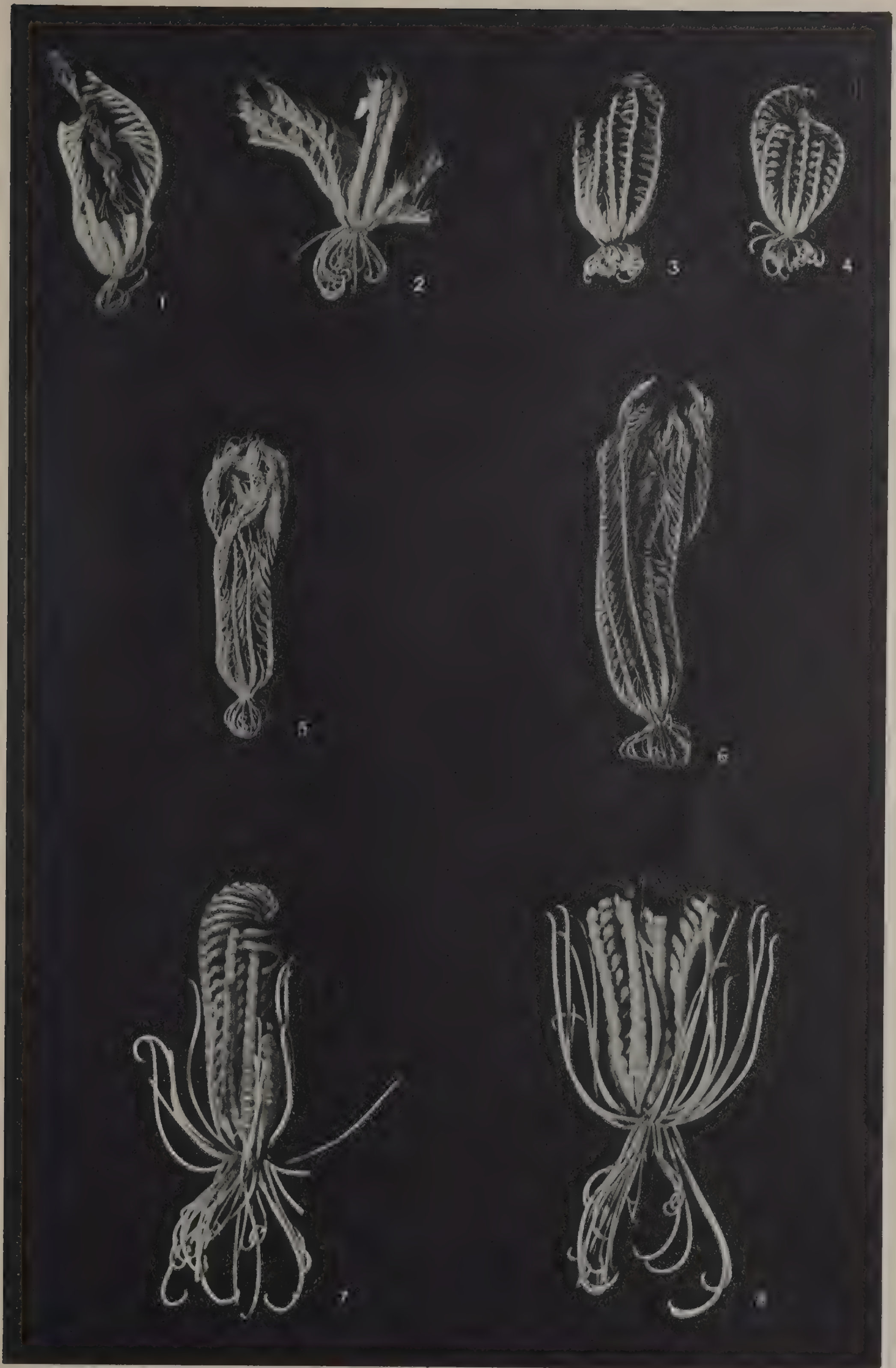

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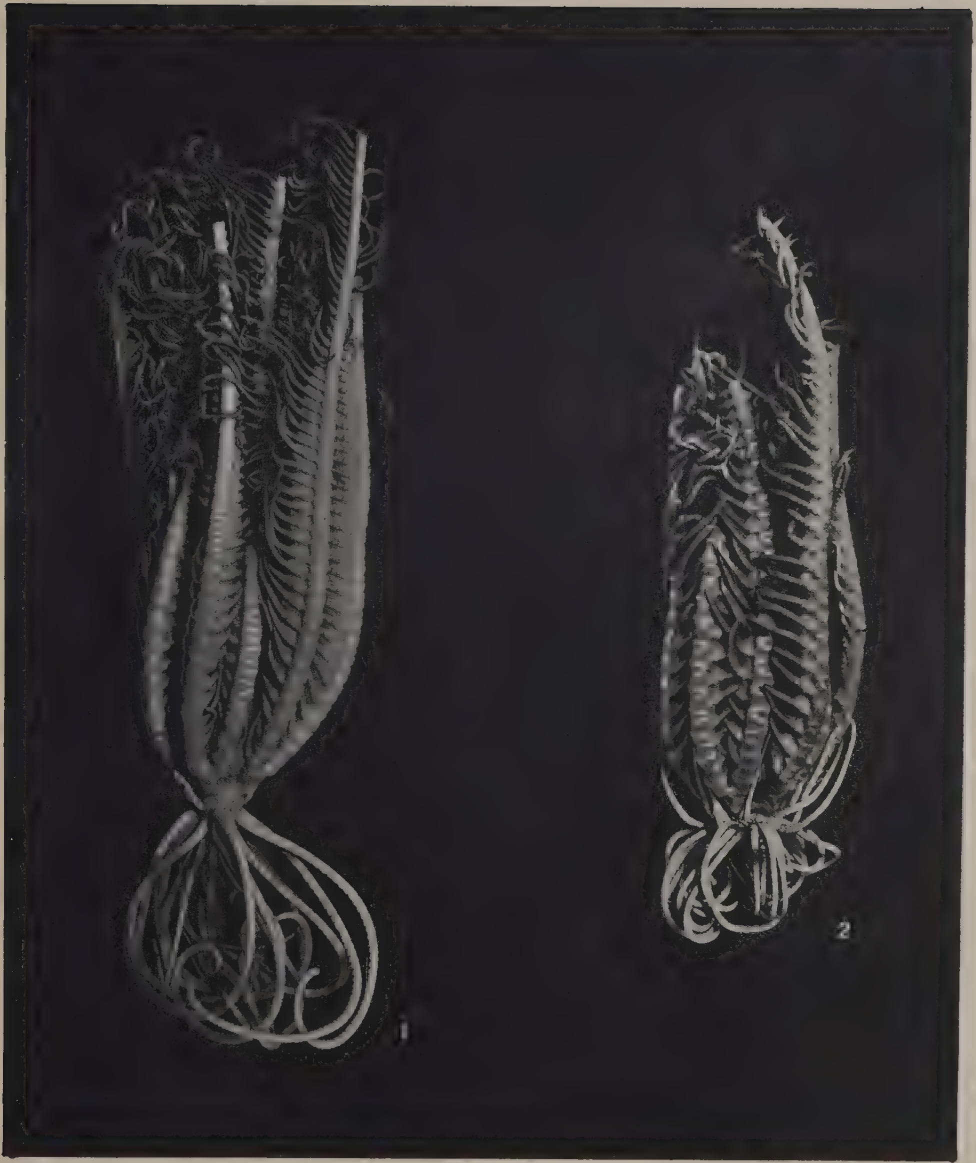
PLATE VI

Fig. 1. *Notocrinus virilis*, ♀, natural size.
Fig. 2. *Notocrinus mortenseni*, ♀, natural size.



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[*Discovery Reports. Vol. XVIII, pp.* 223–238, *January* 1939.]

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THORACIC CIRRIPEDES COLLECTED IN 1925–1936

By

C. A. NILSSON-CANTELL, SWEDEN

THORACIC CIRRIPEDES COLLECTED IN 1925–1936

By C. A. Nilsson-Cantell, Sweden

(Text-figs. 1–5)

INTRODUCTION

In an earlier paper (Nilsson-Cantell, 1930) I have worked out the Cirripedes brought home by the R.R.S. 'Discovery', the R.R.S. 'William Scoresby', and the staff of the Marine Biological Station at South Georgia during the years 1925–7. For the opportunity to study further material from the same expeditions I have to express my best thanks to the former director of the expedition, Dr Stanley Kemp. The greater part of the material was collected during the years 1928–36, but some specimens from the earlier expeditions are also included here, since they were not at my disposal earlier.

Stations made by the 'Discovery' are entered first in the list of localities under the species headings and have no letters prefixed to the numbers. Those of the 'William Scoresby' follow and are distinguished as WS 80, etc. Where the material was collected from whales, the serial number (No. 87, etc.) assigned to it by the Discovery observers is given. A number of the specimens were taken from whales for which such data are not available.

The following symbols are used for nets, apparatus, etc., in accordance with *Discovery Reports*, 1, *Station List*:

BNR	A 100 cm. net attached to a frame 1·47 m. long and 38 cm. wide with skids on either side which keep the mouth of the net 15 cm. above the sea bottom.
BTS	Small beam trawl. Beam 8 ft. in length (2·45 m.): mesh at cod-end $\frac{1}{2}$ in. (12·5 mm.). All measurements are taken from knot to knot along one side of the mesh, not diagonally with the mesh stretched.
DC	Conical dredge. Mouth 16 in. in diameter (40·5 cm.), with canvas bag.
DLH	Large dredge. Heavy pattern, 4 ft. in length (1·2 m.).
DRR	A Russell net frame with rectangular dredge attached instead of a tow-net.
N 100	1 m. tow-net. Mouth circular, 1 m. in diameter: mesh graded, with the cod-end made of stramin, with 11–12 meshes to the linear inch.
N 4–T N 7–T	Nets with mesh of 4 mm. or 7 mm. (0·16 or 0·28 in.) attached to the back of trawl.
N–T	A fine meshed net attached to the back of the otter trawl.
NCS–T	Tow-net of coarse silk, with 16 meshes to the linear inch, attached to a trawl.
NH	Hand net.
NR	Rectangular net.
OTC	Commercial otter trawl. Head rope 80 ft. (24·5 mm.): mesh at cod-end 1$\frac{1}{2}$ in. (3·8 cm.).
OTL	Large otter trawl. Head rope 40 ft. long (12·2 m.): mesh at cod-end 1$\frac{1}{4}$ in. (3·2 cm.).
RM	Mussel rake.

The abbreviations used in denoting the nature of the bottom are:

b. blue	d. dark	gy. grey	r. rock	sh. shells
br. brown	f. fine	m. mud	s. sand	sk. specks
c. coarse	gn. green	p. pebbles	sft. soft	st. stones

The depths of the water at the beginning and at the end of trawling stations are shown, as, e.g., St. 144, 155–178 m.

GENERAL

The number of species in this collection is shown in the following table:

Genus	Total number of species	New species	Species not represented in my earlier *Discovery Report*
Scalpellum	8	2	4
Lepas	1	—	—
Conchoderma	2	—	—
Balanus	3	—	—
Coronula	2	—	—
Total number	16	2	4

This table shows that most of the species are represented in my first paper dealing with Cirripedes from the Discovery expedition (Nilsson-Cantell, 1930). Most species belong also in this collection to the genus *Scalpellum*, only a few of which are known to inhabit deeper water. The identification of young individuals of this genus is always rather questionable, because many species are described from small specimens. It will be seen in this paper, as in the former, that the shape of the valves of the capitulum are rather different in individuals of different age.

Bathymetrical distribution

Name of species	Depth at which taken
Lepas australis	Floating
Conchoderma auritum	,,
,, *virgatum* f. *hunteri*	,,
Coronula diadema	,,
,, *reginae*	,,
Balanus algicola	,,
Scalpellum gibberum	0–253 m.
Balanus laevis	12–78 m.
,, *maxillaris*	27–64 m.
Scalpellum bouveti n.sp.	40–45 m.
,, *rathbunae*	99–107 m.
,, *convexum*	120–383 m.
,, *scoresbyi* n.sp.	146–242 m.
,, *discoveryi*	155–342 m.
,, *angulare*	342 m.
,, *compactum*	567 m.

The first five specimens in this table are typical pelagic forms. One of the *Balanus* species, *B. algicola*, is here found fixed to a fish from the surface. It was at first described as growing on algae, but later on I have found it fixed to the shells of mussels from the littoral. The two remaining *Balanus* species are typical littoral forms. As regards the bathymetrical distribution of the *Scalpellum* species, it may be mentioned that *Scalpellum compactum* and *Scalpellum convexum* are here recorded from deeper water than previously. Since our knowledge is incomplete, it is not possible to draw any conclusions as to the bathymetrical distribution of the *Scalpellum* species here dealt with.

As regards the distribution of Cirripedes this material gives some results beyond those arrived at in the former paper dealing with the Discovery material (Nilsson-Cantell, 1930).

Thus *Scalpellum convexum* is represented not only from South Georgia (where it was previously known to occur) but also from other parts of the Atlantic Ocean, viz. the South Sandwich and South Shetland Islands.

Scalpellum rathbunae is now known from several localities east of Argentina from La Plata down to Patagonia. This characteristic species is likely to be found later on in new localities along the east coast of South America.

Scalpellum compactum seems to be known from the southern part of the Pacific and Atlantic Oceans, the Ross Sea and the Graham Land region. The specimens in this collection are taken from a locality situated near the type-locality: McMurdo Sound.

Scalpellum discoveryi, earlier noted from the Pacific, is, according to this collection also found in the South Atlantic, thus indicating a circumpolar distribution.

Two species of *Scalpellum* are new: *S. scoresbyi* and *S. bouveti*, the former from the waters round the Falkland Islands, the latter east of Bouvet Island.

Lepas australis, a typical pelagic species, is here represented from a locality (St. WS 237) for which the depth is given as 150–256 m. The specimens have certainly been caught by the net near the surface.

Balanus maxillaris, earlier only known from South African waters, is here recorded from the southern part of the Indian Ocean.

Nothing of special interest need be added here regarding the distribution of the other species in the collection.

SYSTEMATIC

Genus Scalpellum Leach, 1817

Scalpellum gibberum C. W. S. Aurivillius, 1892.

For synonymy see Nilsson-Cantell, 1921, *Zool. Bidrag Uppsala*, VII, p. 178.

St. 53. 12. v. 26. Port Stanley, East Falkland Island. Hulk of 'Great Britain'. 0–2 m. Gear **RM**. One small specimen.

St. 652. 14. iii. 31. Burdwood Bank, 54° 04′ 00″ S, 61° 40′ 00″ W. 171–169 m. Gear **OTL**. Several specimens on Hydroids.

St. WS 80. 14. iii. 27. 50° 57′ 00″ S, 63° 37′ 30″ W. 152–156 m., f.d.s. Gear **OTC**. Some small specimens on coral.

St. WS 85. 25. iii. 27. 8 miles S 66° E of Lively Island, East Falkland Island. 79 m. Gear **OTC**. Some small specimens on Hydroids.

St. WS 225. 9. vi. 28. 50° 20′ 00″ S, 62° 30′ 00″ W. 162–161 m., gn.s. sh. p. Gear **OTC**. Several specimens from Hydroids, several specimens from carapace of the crab *Euryfodius* sp.

St. WS 231. 4. vii. 28. 50° 10′ 00″ S, 58° 42′ 00″ W. 167–159 m., f.gn.s. Gear **N 4–T**. One specimen.

St. WS 243. 17. vii. 28. 51° 06′ 00″ S, 64° 30′ 00″ W. 144–141 m., c.d.s. Gear **N 4–T**. Some specimens on Hydroids.

St. 244. 18. vii. 28. 52° 00′ 00″ S, 62° 40′ 00″ W. 253–247 m., f.d.s. m. Gear **N 7–T**. Some specimens on Hydroids.

St. WS 761. 13. x. 31. 44° 22′ 00″ S, 63° 02′ 00″ W. 97 (–0) m., gn.s. m. Gear **BNR**.

St. WS 782. 4. xii. 31. 50° 29′ 00″ S, 58° 23′ 45″ W. 141–146 m., gn.s. Gear **OTC**. One specimen.

St. WS 787. 7. xii. 31. 48° 44′ 00″ S, 65° 24′ 30″ W. 106–110 m., c.br.sk. s. Gear **OTC**. Two small specimens on algae.

St. WS 811. 10. i. 32. 51° 27′ 45″ S, 68° 01′ 30″ W. 98 m., s. st. Gear **OTC**. One large specimen.

DISTRIBUTION. Pacific Ocean (according to Aurivillius uncertain), Atlantic Ocean south of La Plata, Patagonia, Magellan Strait, round the Falkland Islands, where the species seems to be richly represented, 0–253 m.

DISCUSSION. To the supplementary description of *Scalpellum gibberum* given by Nilsson-Cantell, 1930, in *Discovery Reports*, vol. II, nothing need here be added. The localities given above may complete my earlier paper from this expedition.

Scalpellum angulare Nilsson-Cantell, 1930.

Nilsson-Cantell, 1930, *Discovery Reports*, II, p. 239.

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Islands. 61° 25′ 30″ S, 53° 46′ 00″ W. 342 m., r. Gear **DLH**. Four specimens on *Colossendeis*. This specimen is taken from the same locality as the holotype.

Scalpellum convexum Nilsson-Cantell, 1921.

Nilsson-Cantell, 1921, *Zool. Bidrag Uppsala*, VII, p. 194.
Nilsson-Cantell, 1930, *Discovery Reports*, II, p. 244.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay, South Georgia. From 6·3 miles N 89° E of Jason Light to 4 miles N 39° E of Jason Light. 120–204 m., m. Gear **OTL**. Some specimens from Hydroids.

St. 140. 23. xii. 26. Stromness Harbour to Larsen Point, South Georgia. 136–122 m., gn.m. st. Gear **OTL**. One specimen on Hydroids.

St. 371. 14. iii. 30. 1 mile E of Montagu Island, South Sandwich Islands. 99–161 m. Gear **OTL**. Some specimens on Hydroids.

St. 1952. 11. i. 37. King George Island, South Shetland Islands. 367–383 m., sft.m. Gear **DRR**. One specimen on a polychaet tube.

DISTRIBUTION. South Georgia, South Sandwich and South Shetland Islands, 110–383 m.

Discussion. This species is here taken again in four localities. As I was previously able (Nilsson-Cantell, 1930) to study individuals younger and older than the type specimens, it was possible to state that the shapes of the valves of the capitulum are rather different in individuals of different age. The specimen here illustrated from St. 371 must be intermediate between a specimen figured by the author in 1930, text-fig. 9 *d*, and the type specimen (Nilsson-Cantell, 1921, text-fig. 29 *h*). The shape of the carinal latus especially is different in individuals of different age. There are certainly many doubtful species of *Scalpellum* described from young individuals. Thus, for instance, the specimen from St. 371 (Fig. 1) shows a superficial resemblance to *Scalpellum dubium* Hoek, 1883. The mouth parts and caudal appendages are here figured for this individual to show the resemblance to the same parts of the type.

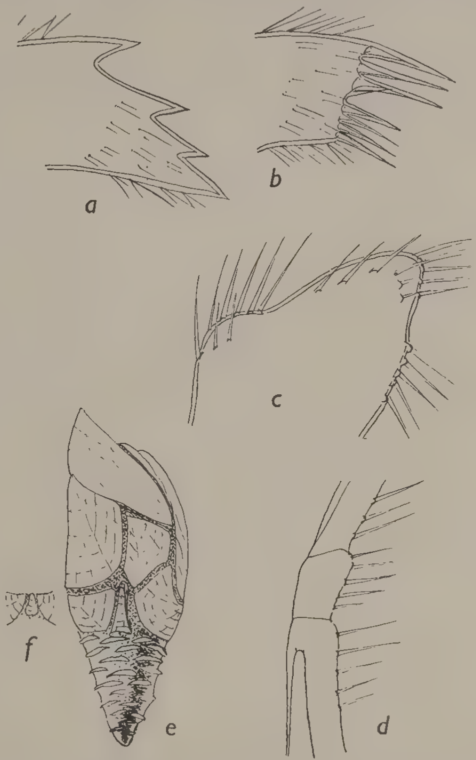

Fig. 1. *Scalpellum convexum* (St. 371). *a*. Mandible. *b*. Maxilla I. *c*. Maxilla II. *d*. Cirrus VI and caudal appendage. *e*. Female (total length 9·4 mm.), lateral view. *f*. Rostrum and rostral latera.

Scalpellum rathbunae Pilsbry, 1907.

Pilsbry, 1907, *Bull. U.S. Nat. Mus.* No. 60, p. 40.
Nilsson-Cantell, 1921, *Zool. Bidrag Uppsala*, vii, p. 184.

St. WS 776. 3. xi. 31. 46° 18′ 15″ S, 65° 02′ 15″ W. 110–99 m., gn.m. s. Gear **OTC**. Two specimens from *Chaetopterus* tubes.

Distribution. Off the east coast of Patagonia. The distribution of this collection is more westerly than Pilsbry's.

Discussion. This well-defined species, earlier mentioned by Pilsbry (1907), and Nilsson-Cantell (1921), is here represented by one small and one full-grown specimen, the later one characterized by its long peduncle (comp. Nilsson-Cantell, 1921). The peduncle is about twice as long as the capitulum. To the description given earlier nothing need be added here.

Scalpellum compactum Borradaile, 1916.

Borradaile, 1916, *Brit. Mus.* (*Nat. Hist.*), *Brit. Antarct.* (*'Terra Nova'*) *Exp.* 1910, *Nat. Hist. Rep. Zool.* iii, No. 4. London.
Nilsson-Cantell, 1921, *Zool. Bidrag Uppsala*, vii, p. 198.

St. 1652. 23. i. 36. 75° 56′ 00″ S, 178° 35·5′ 00″ W. 567 m. Gear **DRR**. Some specimens on Hydroids.

Distribution. Graham Land region, Ross Sea, McMurdo Sound, 91–567 m.

Scalpellum discoveryi Gruvel, 1906.

Gruvel, 1906, *Bull. Mus. Hist. Nat.*, t. 12, Paris, p. 271.

Gruvel, 1907, *Nat. Antarct. Exped.* 1901–1904 ('*Discovery*'), *Nat. Hist.* III, *Crust.* VI, p. 2, London.

Borradaile, 1916, *Brit. Mus.* (*Nat. Hist.*) *Brit. Antarct.* ('*Terra Nova*') *Exp.* 1910, *Nat. Hist. Rep. Zool.* III, No. 4, p. 128, London.

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ 00″ W. 342 m., r. Gear **DLH**. One specimen on *Colossendeis*.

St. 144. 5. i. 27. Off mouth of Stromness Harbour, South Georgia. From 54° 04′ S, 36° 27′ W to 53° 58′ S, 36° 26′ W. 155–178 m., gn.m. s. Gear **NCS–T**. One young specimen.

DISTRIBUTION. McMurdo Sound, east of Solomon Islands (7° 56′ 00″ S, 164° 12′ 00″ E), Clarence Island, South Georgia. 61–342 m.

DISCUSSION. The two specimens dealt with here agree well with the specimen of *Scalpellum discoveryi* Gruvel, 1906, figured by Borradaile, 1916. His specimen and the one illustrated here (Fig. 2) are of about the same size and must be considered as young specimens. It is of great value to illustrate specimens of different age for further investigators. Larger specimens of the same species as figured by Gruvel, 1907, are quite different, owing to imperfectly calcified plates on the capitulum. I have found similar differences before (Nilsson-Cantell, 1930) as regards the species *Scalpellum convexum*.

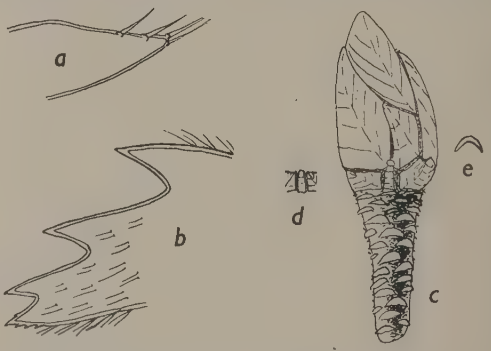

Fig. 2. *Scalpellum discoveryi* Gruvel, 1906 (St. 170). *a.* Palpus. *b.* Mandible. *c.* Specimen, lateral view (total length 9·5 mm.). *d.* Rostrum and rostral latera. *e.* Section through carina.

Internal parts are almost totally unknown. Of the mouth parts only palpus and mandible could be traced (Fig. 2). The palpus is typically conical. The mandible has three teeth and an inner angle a little pectinated. The specimen dissected was a female as stated by Gruvel. No caudal appendages could be traced, as also stated by Gruvel (1907). Further material is necessary to complete the description of internal parts. The description and figures given by Gruvel and Borradaile are sufficient to recognize the species.

Scalpellum scoresbyi n.sp.

St. WS 248. 20. vii. 28. 52° 40′ 00″ S, 58° 30′ 00″ W. 210–242 m., f.gn.s. p. sh. Gear **OTC**. Many specimens on hydrocoralline.

St. WS 249. 20. vii. 28. 52° 10′ 00″ S, 57° 30′ 00″ W. 166 m., f.br.gn.s. sh. st. Gear **DC**. Several specimens.

St. WS 824. 19. i. 32. 52° 29′ 15″ S, 58° 27′ 15″ W. 146–137 m., gn.sk. s. sh. Gear **N–T**. One specimen.

HOLOTYPE. Zoological department of the British Museum.

DISTRIBUTION. East and north of Falkland Islands, 146–242 m.

DIAGNOSIS. *Female.* Capitulum with fourteen plates not much separated by chitinous interspaces and covered by a hairy cuticle. Valves distinctly sculptured by longitudinal ridges and growth lines. Scutum quadrangular with occludent margin slightly convex. Tergum large, triangular. Carina simply arched, umbo apical, dorsal roof convex. Upper latus subtriangular to pentagonal, umbo at apex. Rostrum triangular, umbo apical. Rostral latus low, twice as wide as high. Inframedian latus hour-glass-shaped in full-grown specimens, umbo subcentral, at the apex of a small triangular portion. The rest of the valve with ribs radiating from the base. In younger specimens the umbo is nearly basal. Carinal latus of a curved triangular shape, carinal margin concave, basolateral margin convex, umbo at the base of the carina. Peduncle with transversely elongated scales, cuticle hairy. Mandible with three teeth and an inner angle pointed or with a few fine teeth. Maxilla I with a straight front edge. Maxilla II with a concave front edge with bristles and a posterior lobe with bristles. A distinct maxillary lobe is formed. Caudal appendage single-jointed without bristles, shorter than the proximal segment of the protopodite.

Complemental male sack-like, without cirri and valves.

DISCUSSION AND DESCRIPTION. This new species, which I have named after the R.R.S. 'William Scoresby', *Scalpellum scoresbyi*, seems to be well defined. It seems to be related to *S. botellinae* Barnard, 1924, but differs in many details as regards the valves of the capitulum. The ornateness of the valves and shape of the valves of the capitulum (excluding the carinal latus) suggest that some relation also exists between this new species and *S. brevicaulis*.

Female (Fig. 3). Capitulum covered by a hairy cuticle. There are fourteen well-calcified plates not much separated by chitinous interspaces. The valves are sculptured by longitudinal ridges and growth lines.

Scutum quadrangular with the occludent margin slightly convex.

Tergum large, triangular, with the apex acute, occludent margin straight. Tergum larger than the other valves of the capitulum.

Carina simply arched, umbo apical, dorsal roof convex, without lateral ribs.

Upper latus subtriangular to pentagonal, with the umbo at the apex. The lower part covered by the inframedian latus. The margins are straight.

Rostrum triangular, with the umbo at the apex.

Rostral latus low, about twice as wide as high, with the umbo at the rostral corner. The lateral ridges radiating from the umbo.

Inframedian latus hour-glass-shaped in full-grown specimens. Umbo subcentral at the apex of a small triangular portion. The rest of the valve with ridges radiating from the base. In younger specimens the umbo is nearly basal, but the triangular portion can be traced. In very young individuals the valve is quadrangular.

Carinal latus is of a curved triangular shape, the carinal margin concave, baso-lateral margin convex. Umbo at the base with radiating ribs.

Peduncle of the same length as or somewhat shorter than the capitulum, with distinctly separated transversely elongated scales. Cuticle hairy.

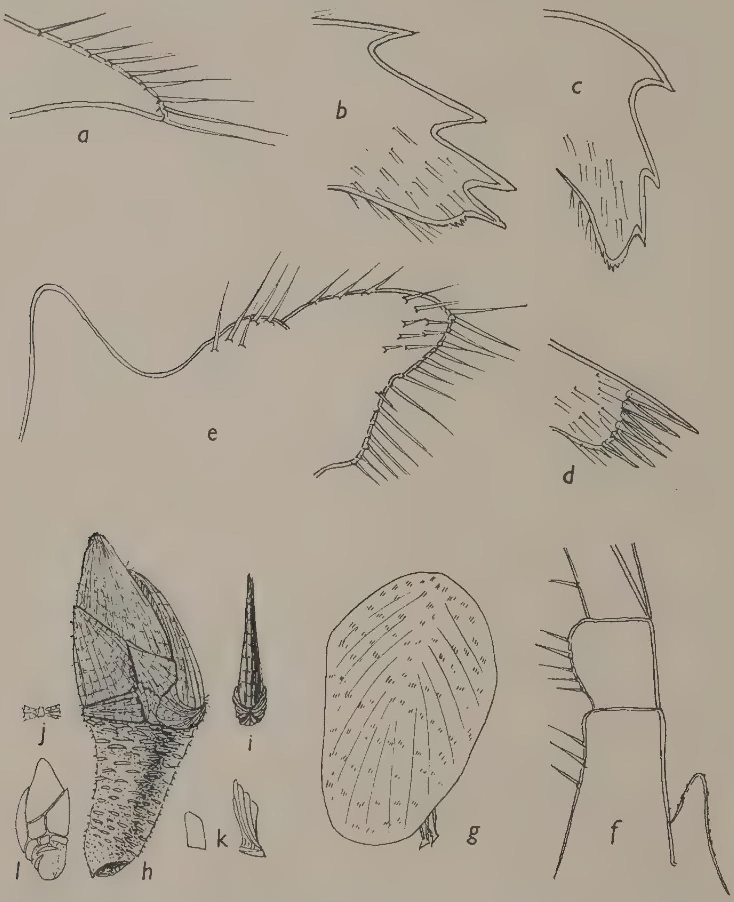

Fig. 3. *Scalpellum scoresbyi* n.sp. (St. WS 248). *a.* Palpus. *b, c.* Mandible. *d.* Maxilla I. *e.* Maxilla II. *f.* Cirrus VI and caudal appendage. *g.* Complemental male (total length 0·82 mm.). *h.* Holotype, lateral view (total length 17 mm.). *i.* The same specimen, carinal view. *j.* Rostrum and rostral latera. *k.* Inframedian latera of younger specimens. *l.* Young specimen (total length 1·5 mm.).

Measurements in mm.

	Length of capitulum	Breadth of capitulum	Length of peduncle	Breadth of peduncle
Holotype	9	5	8	4
Paratype	10	7	10	5

Mouth parts: palpus conical with bristles at the top and side.

Mandible with three teeth, and an inner angle pointed or with a few fine teeth.

Maxilla I with a straight front edge. Maxilla II with a concave front edge with bristles. A posterior lobe with bristles is differentiated. Behind this a conical maxillary lobe is formed.

Number of segments of the cirri

	I		II		III		IV		V		VI		Caudal appendage
Holotype	6	7	9	10	10	11	10	11	10	11	11	12	1

Cirrus I shorter than the other cirri with rami unequal in length. In the longer cirri there are two pairs of spines on the front edge of the segments.

Caudal appendage single-jointed, conical without bristles. The appendage about half the length of the proximal segment of the pedicel of the sixth cirrus.

Complemental male of the sack-like type, without any traces of valves. The surface is minutely spinous (Fig. 3 *g*).

A young specimen (total length 1·5 mm.) here figured (Fig. 3 *l*) has all the valves of the capitulum developed, but of different shape as in full-grown specimens. Thus, for instance, the inframedian latus is quadrangular. In an older specimen (total length 3·5 mm.) it is also quadrangular but a little elongated (Fig. 3 *k*).

Scalpellum bouveti n.sp.

St. 456. 18. x. 30. 1 mile E of Bouvet Island. 40–45 m. Gear **DLH**. One specimen.

HOLOTYPE. Zoological department of the British Museum.

DIAGNOSIS. *Female*. Capitulum with fourteen valves separated by distinct chitinous interspaces. Growth lines weakly marked. Capitulum covered by a thin cuticle. Scutum quadrangular, occludent margin slightly convex. Tergum triangular, occludent margin convex. Carina regularly bent, umbo apical, dorsal roof convex. Upper latus pentagonal, umbo apical, scutal margin concave. Rostrum triangular, elongated, umbo apical. Rostral latus quadrangular, a little wider than high. Inframedian latus triangular, umbo apical, the margins of the same length. Carinal latus pentagonal with the umbo at the middle of the carinal margin. Peduncle with transversely elongated scales, cuticle hairy. Mandible with three teeth and a pectinated inner angle. Maxilla II with a concave front edge with bristles and a posterior lobe with bristles. A distinct maxillary lobe is formed. Caudal appendage single-jointed without bristles, of about the same length as the proximal segment of the protopodite.

Complemental male sack-like, without cirri and valves.

DISCUSSION AND DESCRIPTION. One *Scalpellum* specimen I cannot refer to any previously described species from corresponding parts of the oceans. I think it convenient to erect a new species hoping it will be possible later on to refound it from richer material. It shows some resemblance to younger specimens of *S. convexum*, represented in this collection, but is different especially in the inframedian latus and carina.

Female (Fig. 4). Capitulum covered by a thin cuticle. Valves fourteen in number, separated by distinct chitinous interspaces. The growth lines in this species weakly marked.

Scutum quadrangular with somewhat convex occludent margin.

Tergum triangular with convex occludent margin and recurved apex.

Carina regularly bent with the umbo at the apex. Dorsal roof convex. Sides well developed with wide areas in the upper part.

Upper latus pentagonal with the scutal margin concave and the tergal margin convex. The carinal margin and the margin against the inframedian latus short. The umbo is apical.

Rostrum triangular, elongated with the umbo at the apex.

Rostral latus quadrangular with short basal margin. Width of plate exceeds height.

Inframedian latus triangular, with margins of the same length. The umbo is apical.

Carinal latus pentagonal with the umbo at the middle of the carinal margin. Lateral, upper and basal margins nearly of the same length.

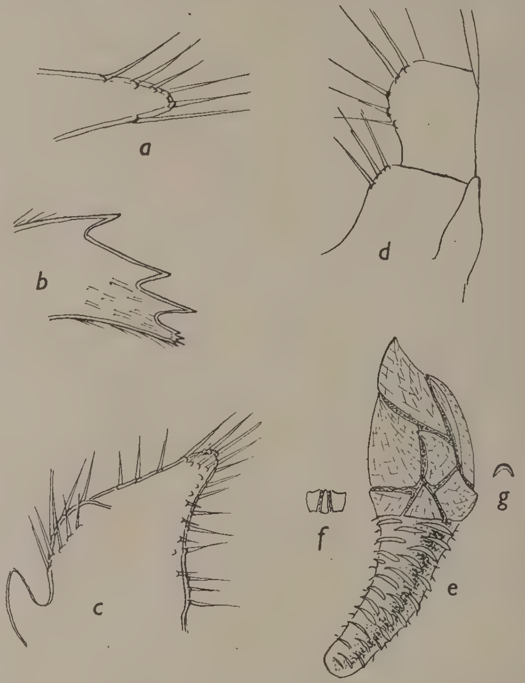

Fig. 4. *Scalpellum bouveti* n.sp. (St. 456). *a.* Palpus. *b.* Mandible. *c.* Maxilla II. *d.* Cirrus VI and caudal appendage. *e.* Holotype (total length 12 mm.), lateral view. *f.* Rostrum and rostral latera. *g.* Section through carina.

Peduncle of the same length as the capitulum, with transversely elongated scales separated by chitinous interspaces. The cuticle a little hairy.

Measurements in mm.

	Length of capitulum	Breadth of capitulum	Length of peduncle	Breadth of peduncle
Holotype	6	4	6	2

Mouth parts: palpus conical with bristles at the point. Mandible with three teeth and a pectinated inner angle. Maxilla I could not be studied in the holotype. Maxilla II with bristles along the whole concave front edge. A posterior lobe with bristles is differentiated like a maxillary lobe.

Number of segments of the cirri

	I		II		III		IV		V		VI		Caudal appendage
Holotype	6	8	12	12	12	12	12	13	12	13	14	14	1

Cirrus I shorter than the other cirri, rami unequal in length with two segments.

Cirrus IV with six pairs of spines on the front edge of the segments. The caudal appendage is single-jointed and pointed without bristles. The appendage is about the same length as the proximal segment of cirrus VI.

The *complemental male* is of the reduced sack-like type.

In the capitulum a number of *cypris stages* were found, indicating that the specimen dissected was mature. As earlier stated (Nilsson-Cantell, 1921) several *Scalpellum* species from Antarctic and sub-Antarctic seas as for instance *S. gibberum*, *convexum*, *compactum* and *ventricosum*, like this new species, have the first development until metanauplius or cypris stage in the mantle cavity.

Genus **Lepas** Linné, 1767

Lepas australis Darwin, 1851.

Darwin, 1851, *Monogr. Lepadidae*, p. 89.

St. 63. 22. v. 26. 48° 50′ 00″ S, 53° 56′ 00″ W. Surface. Gear **NH**. Some smaller specimens on floating *Macrocystis*.

St. WS 69. 22. ii. 27. 52° 19′ 00″ S, 52° 11′ 00″ W. 0–5 m. Gear **NH**. Some specimens on *Macrocystis*.

St. WS 237. 7. vii. 28. 46° 00′ 00″ S, 60° 05′ 00″ W. 150 m., c.br.s. sh. Some specimens on *Laminaria*.

3. v. 32. 48° 00′ 00″ S, 99° 00′ 00″ E. Some specimens on algae brought up on wire.

DISTRIBUTION. Pelagic with a wide distribution in the southern hemisphere. According to Gruvel (1910) the species is held to have a cosmopolitan distribution. No localities are recorded from the northern seas. Here it is taken north and east of Falkland Islands and from the South Indian Ocean.

Genus **Conchoderma** Olfers, 1814

Conchoderma auritum (Linné, 1767).

For synonymy see Nilsson-Cantell, 1921, *Zool. Bidrag Uppsala*, VII, p. 240.

26. xii. 34. 57° 20′ 00″ S, 32° 00′ 00″ W. From Humpback whale. Three specimens on *Coronula diadema* from lower jaw. Taken by S.S. 'Sourabaya'.

5. xi. 30. South Georgia. From a Fin whale, No. 3281, ♀, 22·3 m. Two specimens from baleen plate.

1934–5. South Atlantic. From a Blue whale. Some large specimens on *Coronula diadema*.

June 1930. Durban. From a Sperm whale. Several specimens from jaw.

19. xi. 28. South Georgia. From a Blue whale, No. 1933, ♀, 24·6 m. One specimen on *Coronula reginae*.

20. iii. 28. Husvik, South Georgia. From a Sperm whale. Some smaller specimens cut off teeth.

DISTRIBUTION. Cosmopolitan and pelagic, on *Coronula* attached to whales, on teeth and baleen plates of whales. Also situated on such objects as fishes, eels, ships and buoys.

DISCUSSION. To the supplementary description given by Nilsson-Cantell, 1930, nothing need be added here.

Conchoderma virgatum f. hunteri (Owen, 1830).

Conchoderma hunteri Darwin, 1851, *Monogr. Lepadidae*, p. 153.

Conchoderma virgatum f. *hunteri* Broch, 1931, *Vidensk. Meddel. Dansk. naturh. Foren. Kjøb.* 91, p. 28.

22. iv. 35. No locality given. Several specimens from ventral thoracic region of *Exocaetus* sp., which flew on board.

DISTRIBUTION. Indian and Pacific Ocean.

DISCUSSION. The specimens of this collection were taken from a flying fish. This variety was formerly noted from snakes and decapods. The typical form of *Conchoderma virgatum* is taken also from *Mola mola* and *Gymnothorax favagineus* (*Lycodontis favaginea* (Schneider)).

Genus **Balanus** da Costa, 1778

Balanus algicola Pilsbry, 1916.

Balanus algicola Pilsbry, 1916, *Bull. U.S. Nat. Mus.* No. 93, p. 72.

7. viii. 36. Simonstown, dry dock. Some specimens grouped round the spines of the second dorsal fin of *Squalus acutiformis*.

DISTRIBUTION. South Africa.

DISCUSSION. This species, discovered by Pilsbry, 1916, is easily recognizable by its opercular valves. It was first described on small individuals, fixed on algae. The interesting find of this expedition shows that it does not only occur on algae. It is here found on a spine of *Squalus* (Fig. 5), a rare habitat for the genus *Balanus*. According to Gruvel (1910), a small specimen of *B. maxillaris* is found on a spine of *Acanthias vulgaris*, also from Simonstown. Probably this specimen is to be preferred to *Balanus algicola*, a species not known before 1916. *B. improvisus* is also mentioned by Ciurea, Monod and Dinulesco, 1933, from a fish, the mandible of *Lucioperca lucioperca*. From other material I have found *Balanus algicola* fixed even on mussel shells. These examples also show that the species is not always of very small size, as Pilsbry deduces from the type material. The specimens were, like some of Pilsbry's specimens, violet-coloured.

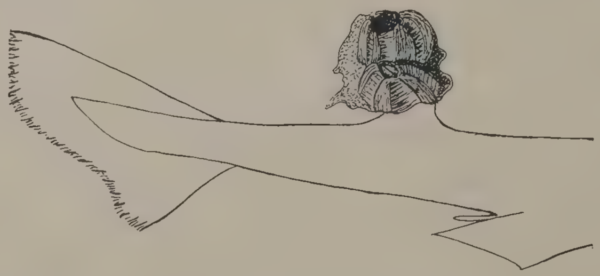

Fig. 5. *Balanus algicola* Pilsbry, 1916. Specimens fixed on spine of the second dorsal fin of *Squalus acutiformis*.

Balanus maxillaris Gronovius, 1763.

For synonymy see Nilsson-Cantell, 1930, *Discovery Reports*, II, p. 254.

St. WS 124. 9. vi. 27. Gough Island, Penguin Island anchorage, 40° 16′ 00″ S, 9° 58′ 00″ W. 40–60 m. Gear **DLH**. Some shell fragments.

St. WS 834. 2. ii. 32. 52° 57′ 45″ S, 68° 08′ 15″ W. 27–38 m., d.b.gy.st. m. s. Gear **OTC**. Several full-grown specimens.

St. WS 836. 3. ii. 32. 53° 05′ 30″ S, 67° 38′ 00″ W. 64 m. Gear **BTS**. Some full-grown specimens.

DISTRIBUTION. South Africa: Cape of Good Hope, Cape Town, Algoa Bay; South Atlantic: Gough Island.

SUPPLEMENTARY DESCRIPTION. The Discovery material previously examined (Nilsson-Cantell, 1930) contained only young specimens of this species. Since the specimens here dealt with are full-grown, I will give figures and a description of internal parts not previously studied.

Balanus laevis Bruguiere, 1789.

For synonymy see Nilsson-Cantell, 1921, *Zool. Bidrag Uppsala*, VII, p. 321.

St. WS 249. 20. vii. 28. 52° 10′ 00″ S, 57° 30′ 00″ W. 166 m., f.br.gn.s. sh. st. Gear **DLH**. Three small specimens on wood.

St. WS 583. 2. v. 31. 53° 39′ 00″ S, 70° 54′ 30″ W. 14–78 m., s. st. Gear **BTS**. Several specimens on stones.

DISTRIBUTION. California, Chile, Peru, Tierra del Fuego, Magellan Strait, Falkland Islands, South Argentina and South Brazil, South Sandwich Islands, Chinca Islands. From the tidal zone down to 275 m. (Nilsson-Cantell, 1921). The species is found on stones, shells, tubes, wood and according to Darwin also on *Balanus psittacus* (Molina, 1892), Darwin, 1854.

DISCUSSION. To the description previously given of this species nothing need be added here.

Genus **Coronula** Lamarck, 1802

Coronula diadema (Linné, 1767).

For synonymy see Nilsson-Cantell, 1921, *Zool. Bidrag Uppsala*, VII, p. 371.

26. xii. 34. 57° 20′ 00″ S, 32° 00′ 00″ W. From a Humpback whale. Three specimens with *Conchoderma auritum*. Taken by S.S. ‘Sourabaya’.

1934–35. South Atlantic. From a Blue whale. Two large specimens with *Conchoderma auritum*.

DISTRIBUTION. Probably cosmopolitan. The species is not yet known to occur universally in the oceans. No examples are known from the equatorial parts of the Atlantic Ocean. From the Indian Ocean a fragment of the wall is taken north of Zanzibar from a depth of 818 m. (Weltner, 1922).

SUPPLEMENTARY DESCRIPTION. In my earlier paper on the Discovery material I noted a specimen with a carino-rostral diameter of 53 mm. and a height of 42 mm. The largest specimen of this material measured 70 mm. in carino-rostral diameter and 42 mm. in height.

Coronula reginae Darwin, 1854.

For synonymy see Nilsson-Cantell, 1926, *Ark. Zool.* Bd. XVIII *a*, No. 27, p. 15.

19. xi. 28. South Georgia. From a Blue whale, No. 1933, ♀, 24·6 m. One specimen with *Conchoderma auritum.*

12. iii. 25. South Georgia. From a Blue whale, No. 87, ♂, 22·05 m. Some specimens.

29. xii. 30. South Georgia. From a Blue whale, No. 3519, ♂, 25·43 m. Some smaller specimens of different sizes.

DISTRIBUTION. This species is probably cosmopolitan. Hitherto it has been taken from the Arctic and Antarctic seas, the Northern and Southern Atlantic and Pacific Oceans. As the species is attached to whales it has been found in many localities, chiefly where there are whale fisheries.

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THE LEOPARD SEAL *HYDRURGA LEPTONYX* (DE BLAINVILLE)

BY

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ERRATA

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p. 241, line 15 *for* no. 1901 *read* no. 1091

p. 245, in the list of specimens under South Shetland, 1921
delete South Sandwich region

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THE LEOPARD SEAL *HYDRURGA LEPTONYX* (DE BLAINVILLE)

By J. E. Hamilton, M.Sc.

(Plates VII–XIII; Text-figs. 1–6)

INTRODUCTION

The leopard seal (*Hydrurga leptonyx*) is the second largest of the Phocidae but it has been somewhat neglected by zoologists, owing no doubt to the belief that it is a common species, and a little search of the records of it will show that, although it is very widely distributed in the Antarctic and Subantarctic regions, it is one of the rarer seals.

I would express my sincere thanks for assistance in this research to the Staff of the British Museum (Natural History), to Dr A. J. E. Cave, Curator of the Physiological Collection in the Royal College of Surgeons who had prepared for me the original of Plate XIII, and particularly to Mr G. C. L. Bertram of the Zoological Laboratories, Cambridge, who generously placed at my disposal the valuable collection of material derived from this species which he collected during the British Graham Land Expedition 1935–7. I would also record my gratitude to Mr Charles Robertson, Manager of Port Stephens Station, West Falkland, for assistance in forming my own collection.

HISTORICAL

The original description of the leopard seal is that of de Blainville (1820) and it was based on two specimens, one skull in the collection of the College of Surgeons, no. 1901, and a skull with the skin in the collection of M. Hauville at Havre. Barrett-Hamilton has discussed the College of Surgeons' specimen in the 'Southern Cross' reports (1902) and established its identity. South Georgia is therefore the type locality. The skin and skull at Havre passed to the Musée National d'Histoire Naturelle in Paris, and, owing to the great kindness of M. P. Rode, Assistant at the Museum, I am able to state that the skull is there now. It is a young male and somewhat damaged in the basioccipital region. The skin belonging to this skull became very dilapidated and was destroyed in 1914. These two specimens are therefore syntypes of the species.

Weddell (1825) mentions the "sea leopard" as if he were familiar with it, but the earliest description of it in the flesh is that of Ross (1847), who did not name each of the three species of seal which he described although he discriminates between them. Ross writes: "There were three kinds: the largest of them is of great size, measuring in length nearly 12 feet and six in circumference, but varying much in weight according to the condition of the animal; the heaviest we killed weighed 850 lbs. and yielded upwards of 16 gallons of oil. The largest sized seal is less numerous than the smaller species, and is armed with enormous tusks, fully as large and strong as those of the polar bear, to which also the shape of the head has a very strong resemblance. It should be attacked with caution for although awkward and unwieldy on the ice, it has both the inclination and the means of inflicting severe wounds, and is therefore a formidable creature to engage." He mentions "The middle sized seal [i.e. the Weddell seal], called the sea leopard." The illustration, from a drawing by Hooker, attached to Ross's chapter IV shows a leopard seal in the water. Subsequent explorers have usually mentioned it, and invariably described it as occurring in small numbers and widely scattered if the matter of distribution was considered. Trouessart (1907): "A little less rare than the Ross seal but lives scattered"; Shackleton (1909): "We saw only two sea leopards during the whole period of our stay in the Antarctic"; Mawson (1915): "only three were observed during our two years in Adélie Land." I am able to state that during the period 23 December 1914 to April 1916, thirty-seven leopard seals were recorded by Mr F. Worsley in his own diary. This is an unusually large number. In the MS. report on mammals of the 'Quest' Expedition 1921–2, Wilkins says that not more than twenty leopards were seen during the voyage in the Weddell Sea, a period of twelve weeks.

DISTRIBUTION

Hydrurga is recorded from most of the Subantarctic lands and islands as well as from the Antarctic itself, its distribution extending so far north as to include New Zealand, New South Wales and even Lord Howe Island (30° 31′ S), where John MacGillivray procured the skull of one killed a few days previously. In Patagonia and Fuegia it is rare (A. Milne-Edwards, 1891), but it is well known in South Georgia and the Falklands and there is reason to believe that it is increasing in the latter.

There is some evidence that there is a movement of this species towards the north in winter; Anderson (1905) states that it was absent from Paulet Island from April to October, and from the expedition's headquarters from February to August. Ainsworth (1915) says: "It is present at Macquarie in great numbers from late winter to early summer...." In the Falklands *Hydrurga* is most plentiful in spring and early summer.

NOMENCLATURE

De Blainville described this species under the name of *Phoca leptonyx*, and F. Cuvier (1824) placed it in a different genus, *Stenorhynchus* or *Stenorhinchus*, but mentions the name only in the vernacular and not in the classical form. The occurrence of the two spellings obscures the question of the correct generic name. Cuvier writes: "ce Leptonyx sera pour nous le type du genre *Stenorhinque*, à cause de son museau étroit"; but in 1826 he refers to "Les Stenorhynques" on p. 548 and on p. 549 to "Stenorhynque leptonyx" in capitals, but gives the classical form as *Stenorhinchus leptonyx*. In the same work, in volume 50 (1829), the article "Stenorhynque", p. 503, gives *Stenorhynchus*, and it is stated: "M. F. Cuvier a formé sous ce nom un genre des mammifères carnassiers amphibies, qui comprend une seule espèce: le phoque leptonyx de M. de Blainville. Voyez l'article 'Phoque', 39, p. 548 (Desm.)". The use of rhinch- for rhynch- is, of course, indefensible in classical forms, and even in his own language Cuvier used the "i" and the "y" indiscriminately. It is therefore only reasonable to attribute *Stenorhinchus* to a *lapsus calami*, and it thus becomes a homonym of *Stenorhynchus* which is preoccupied for a crustacean by Lamarck in 1818. The correct generic name is *Hydrurga*, proposed by Gistl in 1848, long before *Ogmorhinus* (Peters, 1875).

MATERIAL AND METHODS

An examination of Table I will show that the specimens which have been examined are of great variety as to age and locality and, it must be added, in completeness of data. Material for the examination of the genital organs is available from the seals more recently killed either by Mr Bertram or myself; we have both found that Bouin's aqueous fluid is admirable for such work in the field and, where transport is a consideration, has the advantage that about five-sevenths of it is water and can therefore be procured locally. The total number of skulls is seventy-two, and among them is the type in the Royal College of Surgeons, and the earliest examples after it to have been examined by a zoologist, the 'Erebus' and 'Terror' specimens used by Gray (1844), which are in the British Museum.

In the field I have found that a rifle of ·22 calibre, using the "long rifle" cartridge, is adequate for killing even these large animals, but it is essential that the bullet be fired into the brain, and as soon as possible the animal should be stabbed in the heart so that it will bleed freely. If this is not done the tissues take a long time to die and the results are sometimes startling. The handling of the carcass is also more difficult. The length in as straight a line as possible from the tip of the snout to the tip of the tail was taken as a routine, and all specimens from one animal have been referred to the number on a label attached to the skull. The method just described is that used for seals on beaches; when they are on ice floes or in the water additional apparatus is necessary, in particular the harpoon, gaff and lance, but in all circumstances the most important matter is the effect of the first shot.

PHYSICAL CHARACTERS

COAT COLOUR

The coat colour of the leopard seal has been adequately described by Barrett-Hamilton (1902) and Wilson (1907), the remarks of the latter on the alteration of the colour of dried skins being specially worthy of regard. Juvenile specimens are so exceedingly rare in collections that I have been able to find only one, and I have never seen any in life. The single skin is in the British Museum and was secured in the Falkland Islands by R. Vallentin; it is in the first furry coat. This specimen is somewhat discoloured by the fat which has soaked into the hair and there become oxidized to a yellow tinge, but fortunately the discoloration is extremely faint. The

Table I. *List of specimens*

Ref. no.	Sex	Body length	Skull length	Locality	Date	Collector
British Museum (Natural History)						
325*a*	m.	—	—	Antarctic Seas	—	Ross (exhibited)
325*b*	f.	—	389	"	—	Ross
325*c*	m.	—	—	New Zealand	—	Knox (exhibited)
325*d*	f.	—	410	Antarctic Seas	—	Ross
325*e*	—	—	—	"	—	"
325*f*	—	—	—	New Zealand	—	No data
325*g*	m.	—	346	"	—	Sir G. Grey
325*h*	f.	—	—	"	—	Sir G. Grey (damaged)
325*i*	f.	—	406	Lord Howe Island	—	J. MacGillivray, H.M.S. 'Herald'
325*j*	—	—	—	New Zealand	—	Wellington Museum
325*k*	—	—	—	Kerguelen	—	'Transit of Venus' Expedition
325*l*	—	—	—	Falkland Islands	—	Coppinger, H.M.S. 'Alert'
325*m*	m.	—	313	"	—	Holmstead
325*n*	f.	—	402	"	—	"
325*p*	—	—	—	No data	—	Purchased
93.9.14.1	f.	—	398	Antarctic Seas	—	Captain D. Gray
1.1.4.15	m.	—	367	Ross Quadrant	—	'Southern Cross' Expedition
8.2.20.54	m.	269	371	"	i. 04	'Discovery' Expedition
8.2.20.56	f.	333	—	"	i. 04	"
14.1.29.1	—	—	313	"	—	'Terra Nova'
14.1.29.2	m.	—	354	"	—	"
38.12.3.2	f.	—	392	Weddell Sea	19. iii. 22	G. H. Wilkins
34.12.4.1	m.	—	394	South Georgia	—	Cmdr. J. Chaplin
Royal College of Surgeons						
1090	m.	—	338	Tasmania	—	No data
1091	—	—	345	South Georgia	—	Kearns, type
1092	f.	—	422	Falkland Islands	—	No data
1093	—	—	338	"	—	"
1094	—	—	336	New Zealand	—	"
1095	f.	—	383	—	—	"
1095.3	m.	—	386	Falkland Islands	—	Mrs Holgate
1095.4	—	—	—	"	—	R. Vallentin (fragments)
1096	—	—	321	—	—	Chevalier
A. 175.i	m.	—	405	South Georgia	—	Sir J. Middleton
A. 175.ii	f.	—	406	"	—	"
British Graham Land Expedition, 1934–6						
B. 14	f.	345	403	Islands of coast of Graham Land	30. iv. 35	G. C. L. Bertram
B. 15	f.	—	406		3. iv. 35	
B. 16	f.	274	385		5. vi. 35	
B. 17	f.	—	425		22. iii. 35	
B. 55	f.	343	—		23. iii. 35	
B. 81	f.	251	379		22. xi. 35	
B. 126	f.	358	431		17. iii. 36	
B. 127	f.	—	420		28. iii. 36	
B. 128	f.	292	392		21. iii. 36	
B. 142	f.	292	397		27. i. 37	
B. 144	f.	305	387		17. ii. 37	
B. 145	f.	300	417		9. iii. 37	
B. 146	m.	272	386	South Georgia	10. x. 36	B. B. Roberts

Table I (contd.)

Ref. no.	Sex	Body length	Skull length	Locality	Date	Collector
South Shetland, 1921						
Sh. ix	m.	—	398	Pack ice, South Sandwich region	February	J. E. Hamilton
Sh. x	f.	—	405		„	
Sh. xvi	m.	—	364		„	
Sh. xviii	f.	—	395		„	
Sh. xix	f.	351	403		„	
Sh. xx	f.	—	402		„	
Discovery Committee						
S.S. 1	f.	305	391	Pack ice, South Sandwich region	18. i. 28	J. E. Hamilton
S.S. 2	m.	273	377		22. i. 28	
S.S. 3	m.	270	384		3. ii. 28	
S.S. 4	m.	294	416		6. ii. 28	
S.S. 5	f.	221	310		21. ii. 28	
S.S. 6	f.	252	373		21. ii. 28	
S.S. 7	m.	248	356		21. ii. 28	
W.S. 574	f.	—	408	Falkland Islands	i. 31	(presented) J. E. Hamilton
W.S. 651	m.	236	340		22. ix. 36	
W.S. 653	m.	221	324		22. ix. 36	
W.S. 654	m.	284	385		22. ix. 36	
W.S. 655	m.	297	396		3. x. 36	
W.S. 656	f.	284	378		3. x. 36	
W.S. 657	m.	244	357		6. x. 36	
W.S. 661	f.	226	310		9. x. 36	
W.S. 662	m.	297	391		23. x. 36	
W.S. 663	f.	250	339		15. x. 36	
W.S. 664	m.	282	380		22. x. 36	
W.S. 665	m.	292	385		22. x. 36	
W.S. 666	m.	288	385		22. x. 36	
W.S. 673	f.	—	377		1936	(presented)
W.S. 679	m.	—	403		1937	(presented)
D.I. 616	f.	—	411		30. x. 34	(found dead)
D.I. 1162	m.	284	384		8. x. 31	

Note. The initials "W.S." and "D.I." only indicate different series of bone labels and have no other significance in the present connexion. They are therefore omitted in textual references.

dimensions are about 100 cm. long and 50 cm. wide at the broadest part, just behind the flippers. The back is rather pale grey with a broad darker stripe down the middle line; the head is grey dorsally but with pale marks round the eyes; the lips and chin are white. The flanks and belly are almost white, sharply divided off from the grey of the back, but there is an irregular and asymmetrical sprinkling of dark spots and streaks on the flanks; the vibrissae are almost black.

The colour distribution and markings are practically the same as in the adult, but the second coat, which can be seen already in the middle of the back, is darker than the first (Plate VII).

BODY FORM AND SIZE

The immature seal of about a year old is very attenuated and almost cylindrical in shape, and with increasing age the principal change is in the development of the thorax and shoulders. This development is considerably more marked in the female than in the male which retains a form reminiscent of the juvenile throughout life, whereas in the large females the thoracic development is very conspicuous indeed. It may be added that the very large head combined with a thin body in youth, or the thoracic development of older animals, greatly facilitates the identification of this species at a distance, since its outline is so different from all the other Antarctic species.

It was first observed by Bruce, during the voyage of the 'Balaena', that the female leopard seal is larger than the male, and Barrett-Hamilton (1902) comments on this. Bruce's statement is fully confirmed by the measurements now available.

The length from the tip of the nose to the tip of the tail is known for eighteen males and ranges from 221 to 305 cm., and of these only one, that is 5·6 per cent, exceeds 300 cm. Twenty females range from 221 to 358 cm. and ten of them, 50·0 per cent, exceed 300 cm. At birth the length is about 120 cm. (Matthews, 1929), and growth is evidently very rapid during the first six months; Valette (1906) secured a male and female of small size on 29 December and they were already 189 and 194 cm. respectively, and S.S. 5 of 21 February is 221 cm. During the second half-year of life the rate of growth appears to be less, since the average of four, of both sexes, killed at the age of about a year is only 233 cm. The averages for body and skull length for the four age groups distinguishable are shown below (Table II). The correlation between body and skull length in large animals is not close. For example, the body length of B. 144 is 305 cm. and the skull length is 387 mm., whereas B. 145 has a body length of 300 cm. but a skull of 417 mm., and B. 16 with a body of 274 cm. has a skull of 385 mm.

Table II

	Body length (cm.)		Skull length (mm.)	
	Males	Females	Males	Females
First year	228·5	232·3	332	332
Second year	253·7	279·3	361·5	387·7
Third year	280·8	303·7	381·5	402·9
Fourth year and over	289·4	328·8	394·4	411·5

It is appropriate to emphasize here that since the leopard seal is an animal of solitary habit it has to be collected as opportunity offers; there can be no question of picking the largest specimen, and the series of the two sexes here considered may therefore be properly taken as representative. (For discussion of age grouping see pp. 248, 250–256.)

Weight. Ross's record of his heaviest specimen, 850 lb., has already been noticed (p. 241). Apart from this the only definite information is that contained in the 'Scotia'

Reports (1915), where the weights of two males are given—no. XLII, 305 cm., 606 lb. and no. XLV, about 4 cm. longer, 630 lb. The 'Scotia' seals were apparently weighed piecemeal, and for no. XLII only 3 lb. were allowed for loss of blood which seems very little indeed: no details of weights are given with reference to no. XLV.

DEVELOPMENTAL STAGES OF THE SKULL

The skull of *Hydrurga* is remarkable for its length, that of the male being slightly less attenuated than that of the female, though the latter has wider zygomatic arches.

The female skull also attains to a greater size and more massive development than the male, and in the majority of specimens distinctions are visible which, although they may appear small when represented by measurements, nevertheless produce substantially different forms. In order to facilitate a comparison of the differences between the sexes two series were selected in which the condylo-basal lengths of one sex were matched as closely as possible in the other. There are fifteen of each.

Table III. *Condylo-basal lengths of skulls*

Ref. no.	Males Length (mm.)	Ref. no.	Females Length (mm.)
651	340	661	339
325*g*	346	663	347
8.20.2.54	371	S.S. 6	373
S.S. 22	377	656	378
664	380	B. 81	379
654	385	B. 16	385
665	385	B. 144	387
B. 146	386	325*b*	389
666	389	S.S. 1	391
662	391	38.12.3.2	392
34.12.4.1	394	B. 128	392
655	396	Sh. xviii	395
Sh. ix	398	B. 142	397
679	403	B. 14	403
S.S. 4	416	B. 145	417

In dorsal view the frontal bones are greatly compressed from the point at which they leave the cranium to form the interorbital bar, but they expand once more to join the maxillae; the transition from the cranial to the orbital part is gradual in the male but rather abrupt in the female, and the bar itself is narrower in the latter. The maxillary expansion is wider in the male, but the preorbital region of that sex tapers rather more rapidly, so that the male has a more pointed snout than the female. In ventral aspect the palate of the female is more rounded anteriorly and less wedge-shaped than that of the male, and the walls of the nasopharynx are closer together. These walls are composed of the vertical parts of the palatines and pterygoids, and in life support the soft palate which in the female therefore is narrower than in the male.

The width of the nasopharynx was measured at the point where the pterygo-palatine sutures most nearly approximate; such measurements give an indication of the width of the nasopharynx but naturally fail to show that in the female the ventral edge of the pterygoid turns inwards towards the middle line, and, as one might say, rolls round on itself, as age increases, whereas in the male the reverse happens, since the edges turn outwards. The width of the soft palate thus decreases in the female but increases in the male, relatively as well as absolutely, with advancing age.

These characters are subject to a considerable degree of individual variation, but in spite of this it is possible to sex well-grown skulls. With juvenile specimens, however, it is difficult and often impossible, at any rate in the present state of knowledge. In very young skulls there is the roundness common to all young animals, and the sexual characters are very naturally not developed. The smallest male, no. 653, an animal about a year old, shows a proportionately normal interorbital measurement but the zygomatic, anterior frontal, maxillary and premaxillary measurements are all rather high compared with the length of the skull (Table IV). In the juveniles of both sexes the pterygoids are turned outwards, and in the females in proportion to the length of the skull the interorbital bar is widest in the youngest specimens.

As in body length so also in skull development the female departs farther from the juvenile condition than the male; the former has typically larger crests than the latter (this applies particularly to the sagittal crest), a more conspicuous narrowing of the interorbital bar, and more massively developed jaws which produce a blunter muzzle, and, finally, it is only in the large females that there is complete fusion of the palatine sutures and of much of the nasal (vertical) wing of the premaxilla to the adjacent part of the maxilla. Even in the largest males fusion of the premaxillae to the maxillae only takes place in the alveolar region.

The osteological changes due to increasing age are analogous in the two sexes, except that, as stated above, they progress farther in the female.

The specimens of each sex are divisible into four groups on grounds of size and osteological characters, and since the former shows a progressive increase and the latter a progressive ossification and development of crests, etc., it is inevitable that the four stages represent stages in the development of the animal. Since it is established that this species has a definite and limited pupping season it is reasonable to conclude that all the seals of a given year will show common characters at any age up to sexual maturity at least, and such definite groups as those mentioned above must be taken to represent the first three years of life; but in the absence of a much larger series than is at present available it is not possible to subdivide the fourth, oldest, group which therefore represents the fourth year and over.

The following measurements were taken on each skull (see Figs. 1 and 2):

(1) Total length, occipital condyle to tip of premaxillae.
(2) Maximum zygomatic width (outside).
(3) Minimum width of frontal bones (interorbital bar).
(4) Maximum anterior width of frontals.

(5) Width of maxillae at level of upper canine teeth.

(6) Width of the anterior margin of the premaxillae.

(7) Width of nasopharynx near ventral end of the pterygo-palatine suture.

(8) Alveolar length from the point of bone between the upper canine and the first cheek tooth to the posterior rim of the alveolus of the fifth cheek tooth, usually on the right side.

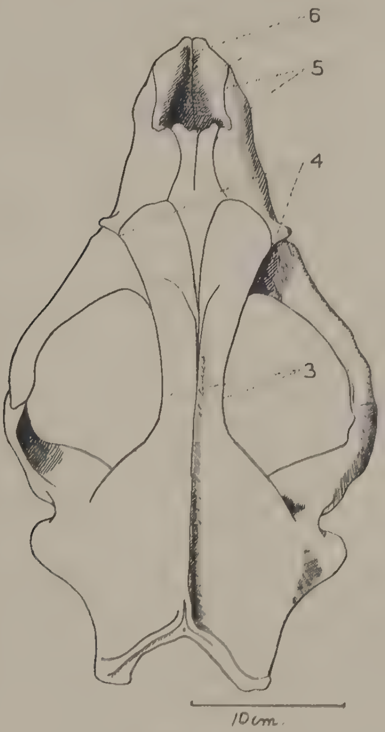

Fig. 1.

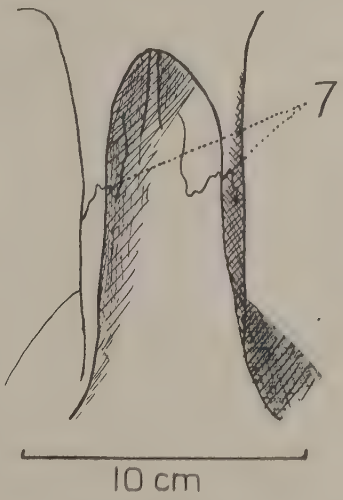

Fig. 2.

Fig. 1. Dorsal view of skull, the numbers refer to the numbered measurements in the text.
Fig. 2. Nasopharyngeal area of skull, the number refers to the measurement bearing the same number.

MALE SKULLS

(Plates VIII, IX and X)

The twenty-eight male skulls vary in length from 313 to 416 mm., and include representatives of the stages from the first year to full growth and maturity.

Ossification never reaches the advanced condition found in some Pinnipedia where the skull may become an almost solid mass of bone. It is no more developed in S.S. 4 of 416 mm. than it is in 662 which is 25 mm. less. The observable fusions are those of the cranium, in the region of the alveolar parts of the maxillae and premaxillae where they are in contact, and in the maxillo-palatine sutures, but the last are fused in only two male skulls and both of them of the largest size.

With increasing age there is a general increase in smoothness and density of bone, most noticeable perhaps in that of the cranium.

In the youngest skulls the lambdoidal suture is only partly fused, but with increasing age it is obliterated, as are the following sutures in the order given: sagittal, squamosal, coronal and occipito-sphenoidal. There are developed very large and thick lambdoidal crests and a less conspicuous sagittal crest which diminishes anteriorly and divides into two low, bilaterally symmetrical ridges marking the temporal lines.

As has been stated on p. 248, four age groups may be distinguished in each sex, and the last undoubtedly comprehends all seals of the fourth year and over.

In the following descriptions average measurements are given unless otherwise specified, and figures in brackets indicate the number of specimens on which was based the immediately succeeding figure:

First year (5). Body length (2) 228·5 cm.; skull length 332 mm.; zygomatic width 172·6 mm.; alveolar length (4) 90·4 mm.

The cranium is rounded and the anterior fonticulus may not be quite closed. The lateral parts of the lambdoidal suture can be seen and the occipito-sphenoidal suture is open; the sagittal suture is rather complex, the coronal sutures are unfused and the squamosal bone is not fused to any other except the periotic and the tympanic. The cheek teeth are crowded, the first in the upper jaw almost touching the canine.

Second year (6). Body length (3) 253·7 cm.; skull length 361·5 mm.; zygomatic width 187·6 mm.; alveolar length 96 mm. The lambdoidal crests are beginning to develop and signs of the sagittal crest give the dorsal profile a straighter line. The lambdoidal suture is obliterated and the sagittal fused, as is also a considerable length of the dorsal part of the coronal sutures. The squamosal suture is fused and the occipito-sphenoidal may be partly closed but is still conspicuous. The cheek teeth are better spaced.

Third year (4). Body length 280·8 cm.; skull length 381·5 mm.; zygomatic width 197 mm.; alveolar length 98·8 mm. The cranium is still smoother and better ossified, the crests are larger and the lambdoidal crest developed to such an extent that the dorsal profile of the skull may be almost saddle-shaped. The occipito-sphenoidal suture is partly fused and there may be fusion of the maxillae and premaxillae on their palatine faces.

Fourth year and over (13). Body length (8) 289·4 cm.; skull length (12) 394·4 mm.; zygomatic width 207·3 mm.; alveolar length (12) 101·9 mm. This final group contains all the largest and most highly ossified skulls; the crests are invariably large and the occipito-sphenoidal suture not only fused but usually obliterated. The premaxillae and maxillae are fused in the alveolar part as well as the palatal.

Table IV. *Measurements arranged in age groups (individuals in order of actual skull length)*

Males

Ref. no.	Body length cm.	Skull length mm.	Zygomatic width mm.	Inter-orbital width mm.	Anterior frontal width mm.	Upper canine width mm.	Pre-maxillar width mm.	Width of naso-pharynx mm.	Alveolar length mm.
First year									
325*m*	—	313	169	38	—	61·5	36	38	86
W.S. 653	221	324	171	37·5	76	65	39	36·5	—
R.C.S. 1090	—	338	173	35	62·5	61·5	38·5	34	95·5
W.S. 651	236	340	175	37	70	61·5	36·5	39	91
325*g*	—	346	175	38	70	60	36	39	89
Second year									
14.1.29.2	—	354	188	37	70·5	61	36·5	41	95
S.S. 7	248	356	193	43·5	78	69	43	40	90·5
W.S. 657	244	357	182	39	73	63	37·5	38	93
Sh. xvi	—	364	183	46·5	81·5	65	43	36·5	93
1.1.4.15	—	367	189	42·5	77·5	65	41	48	95
8.2.20.54	269	371	191	41·5	73	68·5	41·5	47·5	100
Third year									
S.S. 2	273	377	196	42·5	75	69·5	43	47	98
W.S. 664	282	380	193	42	79	71	38	50	98
D.I. 1162	284	384	197	43·5	83	66·5	41·5	49·5	101
W.S. 654	284	385	202	41	84	68	44·5	46·5	98
Fourth year and over									
S.S. 3	270	384	206	43	84	71·5	45	52	98
W.S. 665	292	385	204	43·5	82	73·5	45	58	104
B. 146	272	386	208	45	84	69	43	—	96·5
R.C.S. 1095.3	—	386	210	41·5	89	74·5	45·5	52·5	102·5
W.S. 666	288	389	191	45	80	71	44	57	100
W.S. 662	297	391	214	44	92	71	42	46·5	94
34.12.4.1	—	394	212	45	87	75·5	46	—	101
W.S. 655	297	396	209	44	79	73	44	51	104
Sh. ix	—	398	215	46	87·5	74·5	48·5	49·5	105
W.S. 679	—	403	205	42·5	85	69	46	56	102
A. 175.i	—	405	199	40·5	83·5	73	44·5	52	109
S.S. 4	294	416	214	42	88·5	77·5	48	54·9	107
Additional lengths of males, not referred to skulls									
XLII	305	From *Scientific Results of the 'Scotia'*, vol. IV							
—	231	G. C. L. Bertram, MS. (not used in calculation of average length)							

FEMALE SKULLS

(Plates VIII, IX and X)

The identifiable female skulls are thirty-two in number, and like those of the males display four age groups.

On the whole the female displays rather greater individual variation than the male.

First year (3). Body length 232·3 cm.; skull length 332 mm.; zygomatic width 174 mm.; alveolar length 89·8 mm. At this stage the skulls closely resemble those of the males and exhibit the rounded form, comparatively poor ossification and conspicuous sutures of the immature animal. The vertical plates of the pterygoids are frequently inclined outwards—a juvenile character which is found in the male skull throughout life—and the occipito-sphenoidal suture may begin to fuse. Cheek teeth crowded.

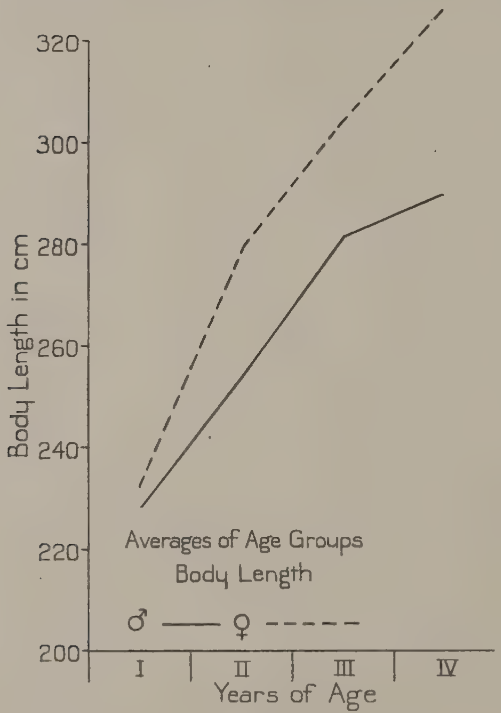

Fig. 3.

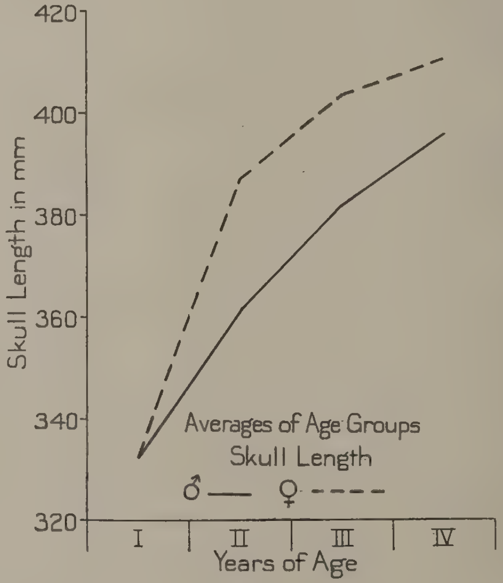

Fig. 4.

Fig. 3. Graphical representation of growth stages of body, both sexes.
Fig. 4. Graphical representation of growth stages of skull, both sexes.

Second year (11). Body length (5) 279·3 cm.; skull length 387·7 mm.; zygomatic width 199·3 mm.; alveolar length 101·5 mm. The bone is denser, the coronal and squamosal sutures are almost entirely fused, the occipito-sphenoidal is usually fused and may be obliterated, and the alveolar length has increased.

Table V. *Proportions arranged in age groups*

Males

Ref. no.	Body length	Skull length as % of body length	Percentages of skull length						
			Zygomatic width	Interorbital width	Anterior frontal width	Upper canine width	Premaxillar width	Width of nasopharynx	Alveolar length
First year									
325*m*	—	—	54·0	12·1	—	19·6	11·5	12·14	27·5
W.S. 653	221	14·7	52·8	11·8	23·5	20·1	12·0	11·3	—
R.C.S. 1090	—	—	51·2	10·4	18·5	18·2	11·4	10·1	28·3
W.S. 651	236	14·4	51·5	10·9	20·6	18·1	10·7	11·5	26·8
325*g*	—	—	50·6	11·0	20·2	17·3	10·4	11·3	25·7
Second year									
14.1.29.2	—	—	53·1	10·5	19·9	17·2	10·3	11·6	26·8
S.S. 7	248	14·4	54·2	12·2	21·9	19·4	12·1	11·2	25·4
W.S. 657	244	14·6	51·0	10·9	20·6	18·1	10·7	11·5	26·1
Sh. xvi	—	—	50·3	12·8	22·5	17·9	11·8	10·0	25·5
1.1.4.15	—	—	51·5	11·6	21·2	17·7	11·2	13·1	25·9
8.2.20.54	269	13·8	51·5	11·2	19·7	18·5	11·2	12·8	27·0
Third year									
S.S. 2	273	13·8	52·0	11·3	19·9	18·4	11·4	12·5	26·0
W.S. 664	282	13·5	50·8	11·1	20·8	18·7	10·0	13·2	25·8
D.I. 1162	284	13·5	51·3	11·3	21·6	17·3	10·8	12·9	26·3
W.S. 654	284	13·6	52·5	10·6	21·8	17·7	11·4	12·1	25·5
Fourth year									
S.S. 3	270	14·2	53·6	11·2	21·9	18·6	11·7	13·5	25·5
W.S. 665	292	13·2	53·0	11·3	21·3	19·1	11·7	15·1	27·0
B. 146	272	14·2	53·9	11·7	21·8	17·9	11·1	—	25·0
R.C.S. 1095.3	—	—	54·4	10·8	23·1	19·3	11·8	13·6	26·6
W.S. 666	288	13·5	49·1	11·6	20·6	18·3	11·3	14·7	25·7
W.S. 662	297	13·2	54·7	11·3	23·5	18·2	10·7	11·9	24·0
34.12.4.1	—	—	53·8	11·4	22·1	19·2	11·7	—	25·6
W.S. 655	297	13·3	52·8	11·1	19·9	18·4	11·1	12·9	26·3
Sh. ix	—	—	54·0	11·6	22·0	18·7	12·2	12·4	26·4
W.S. 679	—	—	50·9	10·5	21·1	17·1	11·4	13·9	25·3
A. 175.i	—	—	49·1	10·0	20·6	18·0	11·0	12·8	26·9
S.S. 4	294	14·1	51·4	10·1	21·3	18·6	11·5	13·2	25·7

Table VI. *Measurements arranged in age groups*

Females

Ref. no.	Body length cm.	Skull length mm.	Zygomatic width mm.	Inter-orbital width mm.	Anterior frontal width mm.	Upper canine width mm.	Pre-maxillar width mm.	Width of naso-pharynx mm.	Alveolar length mm.
First year									
S.S. 5	221	310	178	41	65	63	41	39	83·5
W.S. 661	226	339	173	45	70	64	40·5	42·5	91
W.S. 663	250	347	171	40	70·5	63	39	42	95
Second year									
S.S. 6	252	373	204·5	41·5	78	73·5	45	52	100
W.S. 673	—	377	208	37·5	81	73·5	41·5	41·5	101
W.S. 656	284	378	200	40	80	69	41	48	101·5
B. 81	251	379	187	38·5	70·5	68·5	41	47	99
R.C.S. 1095	—	383	192·5	37·5	65	68·5	42	41·5	98
B. 144	305	387	202·5	44	86	70	42	47	100
S.S. 1	305	391	200	37	73·5	70	41·5	45·5	101
38.12.3.2	—	392	208	42·5	80	74·5	44	49	103
93.9.14.1	—	398	191	39	79	74	41	49	103
Sh. xx	—	402	191	41	74	70	47	43·5	108·5
Sh. x	—	405	208	44	85	76·5	52	49	101·5
Third year									
B. 16	274	385	205	41·5	87	73·5	49·5	43	97
325*b*	—	389	210·5	38	—	73	45·5	46·5	99
B. 128	292	392	218	42·5	85	78	49·5	—	105
325*n*	—	402	223	42·5	92	76	50	42	102
B. 14	345	403	207	42	91	79	52	47	104
B. 15	—	406	206	43·5	84	—	46·5	45	109
325*i*	—	406	221	42·5	78·5	82	—	43·5	103
325*d*	—	410	210	42	92	77·5	45·5	49	108·5
D.I. 616	—	411	202	39	80	72	47	—	102·5
B. 17	—	425	232	43	92·5	79	49·5	—	108
Fourth year and over									
Sh. xviii	—	395	201	36·5	70	71·5	41·5	46	100
325*h*	—	—	220	—	—	—	—	—	—
B. 142	292	397	241	40	80	78	46	48	105
Sh. xix	351	403	200	40	79	72·5	46·5	51	100·5
W.S. 574	—	408	230	40	92	77·5	50·5	46·5	103
B. 55	343	—	234	44	87·5	85	52·5	52·5	110
B. 145	300	417	252	39	92	77	50·5	34·5	99
B. 127	—	420	247	39·5	91	82	50	45	108
R.C.S. 1092	—	421	253	42·5	100	86	55	41·5	112·5
B. 126	358	431	248	41·5	101	90	52	43	109
Additional lengths of females, not referred to skulls									
III	350	From *Scientific Results of the 'Scotia'*				(not used in calculation of average length)			
—	226	G. C. L. Bertram, MS.							
—	315								
—	338								

Table VII. *Proportions arranged in age groups*

Females

Ref. no.	Body length	Skull length as % of body length	Percentages of skull length						
			Zygomatic width	Interorbital width	Anterior frontal width	Upper canine width	Premaxillar width	Width of nasopharynx	Alveolar length
First year									
S.S. 5	221	14·0	57·4	13·2	21·0	20·3	13·2	12·6	26·9
W.S. 661	226	15·0	51·0	13·3	20·6	18·9	11·9	12·5	26·8
W.S. 663	250	13·9	49·3	11·5	20·3	18·2	11·2	12·1	27·4
Second year									
S.S. 6	252	14·8	54·8	11·1	20·9	19·7	12·1	13·9	26·8
W.S. 673	—	—	55·2	9·9	21·5	19·5	11·0	11·0	26·5
W.S. 656	284	13·1	52·9	10·6	21·2	18·3	10·8	12·7	26·9
B. 81	251	15·1	49·3	10·2	18·6	18·1	10·8	12·4	26·1
R.C.S. 1095	—	—	50·3	9·8	17·0	17·9	11·0	10·8	25·6
B. 144	305	12·7	52·3	11·4	22·2	18·1	10·9	12·1	25·8
S.S. 1	305	—	51·2	9·5	18·8	17·9	10·6	11·6	25·8
38.12.3.2	—	—	53·1	10·8	20·4	19·0	11·2	12·5	26·3
93.9.14.1	—	—	48·0	9·8	19·8	18·6	10·3	12·3	25·9
Sh. xx	—	—	47·5	10·2	18·4	17·4	11·7	10·8	27·0
Sh. x	—	—	51·4	10·9	21·0	18·9	12·8	12·1	25·1
Third year									
B. 16	274	14·1	53·2	10·8	22·6	19·1	12·9	11·2	25·2
325*b*	—	—	54·1	9·8	—	18·8	11·8	12·0	25·4
B. 128	292	13·4	55·6	10·8	21·7	19·9	12·6	—	26·8
325*n*	—	—	55·5	10·6	22·9	18·9	12·4	10·4	25·4
B. 14	345	11·7	51·4	10·4	22·6	19·6	12·9	11·7	25·8
B. 15	—	—	50·7	10·7	20·7	—	11·5	11·1	26·8
325*i*	—	—	54·3	10·5	19·3	20·2	—	10·7	25·4
325*d*	—	—	41·2	10·2	22·4	18·9	11·1	12·0	26·5
D.I. 616	—	—	49·1	9·5	19·5	17·5	11·4	—	24·4
B. 17	—	—	54·6	10·1	21·8	18·6	11·6	—	25·4
Fourth year									
Sh. xviii	—	—	50·9	9·2	17·7	18·1	10·5	11·6	25·3
325*h*	—	—	—	—	—	—	—	—	—
B. 142	292	13·6	60·7	10·1	20·2	19·6	11·6	12·1	26·4
Sh. xix	351	11·5	49·6	9·9	19·6	18·0	11·5	12·7	24·9
W.S. 574	—	—	56·4	9·8	22·5	19·0	12·4	11·4	25·2
B. 55	343*	—	—	—	—	—	—	—	—
B. 145	300	13·9	60·4	9·4	22·1	18·5	12·1	8·3	23·7
B. 127	—	—	58·5	9·4	21·7	19·5	11·9	10·7	25·7
R.C.S. 1092	—	—	60·1	10·1	23·8	20·4	13·1	9·9	26·7
B. 126	358	12·0	57·5	9·6	23·4	20·9	12·1	10·0	25·3

* Badly damaged.

Third year (10). Body length (3) 303·7 cm.; skull length 402·9 mm.; zygomatic width 213·5 mm.; alveolar length 103·8 mm. The palatal sutures are beginning to fuse, most frequently starting with the maxillo-palatine followed by the median palatine and the palatine part of the maxillo-premaxillar.

Fourth year and over (9). Body length (5) 328·8 cm.; skull length (8) 411·5 mm.; zygomatic width (10) 232·6 mm.; alveolar length 105·2 mm. The palatine sutures are fused and obliterated, the premaxillae are fused to the palatal and alveolar parts of the maxillae, and this fusion is continued along the vertical suture between these bones as far as half-way up, but the upper parts of these sutures are not fused in any skull so far examined.

OS PENIS

(Plate XI)

The penis bones were not examined until it had been decided that there were four age groups in the skulls, but when they were, they clearly provided an additional means of distinguishing age groups. The smallest bone is that belonging to 325 *m*, which is the smallest male skull, 313 mm. (first year). This os penis is 96 mm. long and about 2·5 g. in weight; it is curved in a dorsal direction with the maximum flexion about 34 mm. from the distal end, but beyond this point the axis of the bone returns to approximately its original line. The ventral surface has a narrow urethral groove for most of its length and there is a perceptible dorsal keel. The bone belonging to a second year animal, no. 657, is 132·5 mm. in length and 7·2 g. in weight; it is straighter than the bone of 325 *m*, but the distal part bends slightly downwards from about 38 mm. from the tip; the dorsal keel is less sharp, and about 40 mm. from the proximal end there are two elevations which mark the insertion of the ischio-cavernosus muscles.

The os penis of the third year, no. 664, exhibits a very marked increase in size since it is 180 mm. long and weighs 27·5 g. and is altogether a more massive structure. For most of its length the urethral groove is represented only by a flattening, but the dorsal keel is well marked. The sudden increase in size and weight compared with the bone of the preceding year—an increase of almost 36 per cent in length and of 380 per cent in weight—supplies adequate reason for belief that the third year is that which marks the onset of sexual activity, and this is in accordance with the structure exhibited by the pertinent testicular sections, that of no. 657 being juvenile in character but no. 664 showing definite signs of the adult condition.

The remaining four bones are the massive structures of the adult, although there are indications that with sufficiently long series at least one additional growth stage could be distinguished; the bones of nos. 662 and 655 are deeper and more compressed than those of nos. 665 and 666, with the ventral surface edged rather than flattened as it is in the last two.

To summarize, the os penis shows a continuous increase in size up to that of the adult, and there is a sudden enlargement in the third year when the animal first becomes sexually active; there is also a progressive alteration in shape from one which is curved and almost cylindrical in section with a perceptible urethral groove to one which is nearly straight, sharply elliptical in section and almost devoid of a groove. The bone in the adult is not quite bilaterally symmetrical and exhibits conspicuous individual variation.

Table VIII. *Growth of the os penis*

	Ref. no.	Length mm.	Weight g.
First year	325*m*	96·0	2·5
Second year	657	132·5	7·2
Third year	664	180·0	27·5
Fourth year and over	665	225·5	39·5
	666	238·0	51·5
	662	240·0	59·0
	655	225·0	61·5

TEETH

As is well known the dentition of the leopard seal is $\frac{2}{2}\frac{1}{1}\frac{5}{5}=32$, and compares favourably with that of any other carnivore: no variations in number have been found in the seventy-two specimens examined. It is a matter for regret that there is no material for a description of the milk dentition.

The frequency of broken teeth is commented on (p. 259), but as an example of an advanced state of injury the very large female no. 1092 in the Royal College of Surgeons may be described. The second lower left incisor is lost and the canine broken; the injury to the canine and the displacements are illustrated in Pl. XIII. Of the ten cheek teeth in the upper jaw only four are complete, the remaining six being broken in varying degrees; some indeed are destroyed. There is only one broken cheek tooth in the mandible.

PATHOLOGICAL CONDITIONS

(Fig. 5)

In skull no. B. 55, about the beginning of the ascending ramus of the right mandible there are two bony nodules, one inside and the other outside and also numerous similar nodules of varying size on the anterior and ventral parts, there being at least ten on the palate alone. Five of these structures have been sawn through and some show a dense outer layer of bone with more cancellous structure within, but others are composed of dense bone throughout. In the left ethmoturbinal of the same skull there are two irregularly shaped nodules which are perfectly free in the dried specimen; they are both extremely dense.

Skull no. 656 has two partly healed wounds in the bones of the face, and like similar lesions seen in other skulls they have apparently been caused by another leopard seal, as they are about the size one would expect to result from the use of the canines of

Hydrurga. There are also signs of inflammation in the alveolar region of this skull. It is a matter for speculation whether channels for infection may not have been opened either by the breaking of the teeth or the reception of wounds. It is well known that seals' wounds are almost invariably septic.

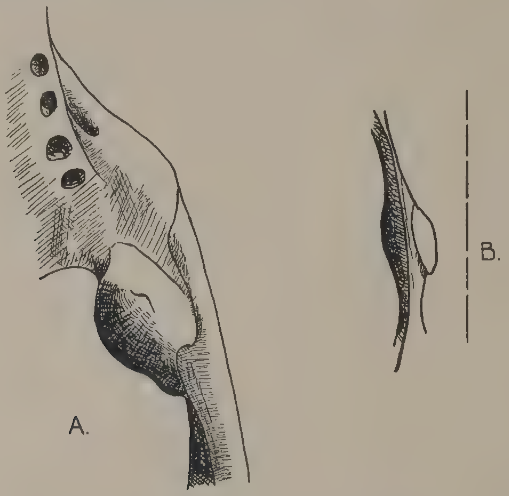

Fig. 5. Pathological nodules on skull of B. 55. *A*, on the zygomatic process of the left maxilla and *B*, on the right pterygoid.

FEMALE GENITALIA

The genitalia of no. 656 were preserved; this animal showed only early and microscopical signs of sexual activity, so that the following is a description of a young virgin (Pl. XII).

The ovaries are enclosed in almost complete capsules and are of a flattened bean-like form; the right organ is 2·8 by 1·4 cm. The cornua are rather short (13·2 cm.), and

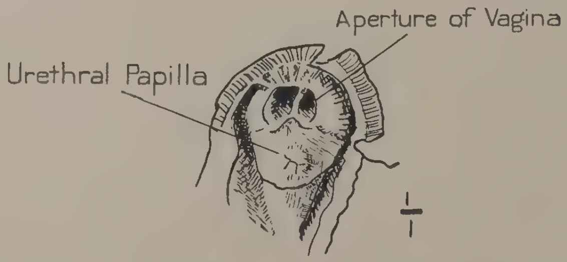

Fig. 6. Dorso-posterior view of the vaginal aperture of no. 656, showing the hymeneal band.

there is no projecting cervix. The vagina is 16·2 cm. in length. Its opening projects into the vestibule immediately before the urethral papilla and has a strap-like hymeneal band in a more or less median position. When fully straightened this band is 14·2 mm. long (Fig. 6). The vestibule, to the tip of the clitoris, is 9 cm. in length, so that the total length of the passage, excluding the Fallopian tube, is 38·4 cm. The hardness of the specimen did not permit a dissection of the last-named portion. The clitoris is small and surrounded laterally and posteriorly by a low pad, presumably the homologue of the labia minora; pigmentation of the integument begins about the level of this organ.

BIONOMICS

HABITS AND FOOD

Outside the breeding season *Hydrurga* appears to spend most of its time feeding, or sleeping off its meals on shore or on pieces of ice. A most striking characteristic is the solitariness of its life; even if more than one be present on a beach the observer receives a strong impression of each seal being independent of the others and exhibiting the most complete indifference to them, in this contrasting very conspicuously with many other Pinnipedes. In water or on the ice it is much the same, and ordinarily these seals occur widely scattered. In thirty or forty miles steaming in open pack one may meet only three or four. The ten recorded in one day by Worsley (MS.) is quite an exceptionally high number. It is only in the rutting season that they have been observed to take any interest in one another.

Although like most other Pinnipedes this species tries to retreat when approached by man, it is more resentful of molestation than the other southern species, particularly in the water. Ponting (1922) describes how he irritated a leopard seal to such an extent that it pursued him over the snow until he was able to call in the assistance of E. A. Wilson who collected the specimen thus offered to him. Its reaction to interference in the water has earned it, in South Georgia, a reputation for ferocity which is scarcely justified.

In the Falklands, reports occur from time to time of *Hydrurga* "attacking boats" or even leaping into them and attacking the occupants, but since it is extremely likely that the humans concerned took the first step by assaulting the seal the greatest caution must be observed in accepting such evidence.

Shackleton (1920) writes that "a huge sea leopard climbed on to a floe and attacked one of the men"; since it is known that other seals are seized in this manner it may be that the leopard seal mistook the man on the ice for a Pinnipede (see p. 260).

A Falkland Island report that a sheep dog has been killed by one of these animals is of course entirely credible, but one can hardly on that account support the thesis that *Hydrurga* is an evil creature. It seems probable that there is a good deal of fighting among these seals. Tooth marks on the skulls are to be found from time to time, some of them very severe, and broken teeth are fairly common, particularly in the large females, but whether these are due to accident, combat or courtship cannot be stated.

The leopard seal has no natural enemies except perhaps the killer whale; Wilson (1907) mentions a seal which had been badly torn, and my specimen, no. 666, had on the neck two large old scars which had the appearance of marks left by the killer whale.

The skull of the young female no. 661 had the right frontal and maxilla damaged to such an extent that a large fragment composed of parts of these two bones is detached in the dry skull; the pointed posterior end of the broken frontal projected from the line of the skull when fresh, and the edges of the bones show signs of regeneration; there is a place on the crown where a fragment of the left parietal has been pushed down below the level of the rest of the bone and has fused in that position, but there were no skin markings to indicate the exact nature of the agency which produced such injuries.

Even if it were necessary it would be very difficult to avoid the belief that the ferocity of *Hydrurga* is one of the reasons for its solitary mode of life, but it may also be a reflection of another of its characteristics, one unique among the Pinnipedia, that of being a carnivore of large appetite and catholic taste. Besides being an eater of fish and cephalopods it is well known as a principal enemy of the penguins. Levick (1915) has well described the seal's habit of lying in wait at penguin jumping-off places. R. N. R. Brown (1906) records the snatching of a penguin from a piece of ice, and I have myself seen it run down and catch a ringed penguin in open water, an impressive demonstration of the speed of the mammal. Penguins are roughly shaken from their skins, but a great deal of skin and feathers is swallowed; the faeces of animals which have been feeding on penguins are almost entirely composed of feathers. Other birds, e.g. *Macronectes* and *Pelecanoides*, are taken if opportunity offers.

This species has frequently been seen feeding on the carcasses of whales and seals killed in the south. If large fragments are attacked pieces are grasped with the teeth and torn off by rotary movements.

Hydrurga quite commonly feeds on other seals but not, so far as is known, on its own kind; Mawson (1915) records having seen a Weddell seal eaten, and the chase of a crab-eater, which after several narrow escapes took refuge on an ice-foot. This was not necessarily safe: I was once called on deck in the pack to see a leopard seal which had jumped on to an ice-cake and attacked a crab-eater there. When I came out the leopard seal had disappeared but the prey had been torn open and killed, the ice as well as the carcass being smothered in fresh blood. A preference is shown for the softer parts of other seals, blubber, guts, etc.

The results of the examination of the stomach and gut contents of thirty-two animals are recorded by the following: Gray, 1844, 1; Ross, 1847, 1; E. A. Wilson, 1907, 2; Bruce, 1915, 7; G. C. L. Bertram, MS., 6; J. E. Hamilton, *subter*, 15. They are as follows:

Nature	Occurrences
Penguin	8
Carrion	5; seal 4, whale 1
Squid	4
Seal, fresh	4, phocid and *Otaria* pup.
Fish	4, one contained 28 lb.
Crustacea	3; unnamed 2, *Euphausia superba* 1
Pelecanoides	1
Ascidians, composite	1
Alga	2, probably accidental
Empty	4

SEXUAL MATURITY

Males. Pieces of testis and epididymis from the following have been sectioned: nos. 651, 653, 654, 655, 657, 662, 664, 665 and 666. Of these nos. 651 and 653 are the two smallest animals and the sections are obviously those of juvenile testes: the lumina of the tubules are not yet developed, and there is of course no trace of spermatogenesis. In no. 657 the organ is somewhat more advanced, since lumina are beginning to appear in the form of irregular central spaces in the tubules, but spermatogenesis has not begun. Of the remaining six, three, nos. 654, 664 and 665, are in a state of almost complete inactivity: a few sperms only may be found by searching and large syncytial cells are present in all, although fewest in no. 664 which is the least active. No. 654 has a very few sperms in the epididymis and no. 664 none. The last three testes are those of nos. 655, 662 and 666; no. 662 shows a slight amount of general spermatogenesis, and a mass of sperms which is of limited size appears in three or four contiguous sections of the epididymial tubule. The other sections of it in the same slide are empty. Nos. 655 and 666 are both more active than no. 662, but neither of them appears to be fully so. Sperms are present in the ducts of both and there are syncytia in the testis of no. 666.

From the evidence available, derived from the condition of the os penis and the testes, it must be concluded that sexual activity does not begin until the third year, and that animals of that age are adolescent, the fourth year being that of sexual maturity. There does not appear to be a definite anoestrous season in the male of *Hydrurga* as a species, but this does not exclude the possibility of a resting period for individuals such as no. 665.

Females. Ovaries of six non-pregnant animals have been examined. The two first-year animals, nos. 661 and 663, have characteristically juvenile organs, although under the microscope a very early stage of a Graafian follicle was found in the ovary of no. 663. In the second-year seals, no. 656 has many primordial follicles and numerous developing Graafian follicles of microscopic size. This animal was killed in October and was a virgin. S.S. 1, killed 18 January, has follicles up to 4·5 mm. in diameter and a corpus luteum of 26 mm. longest diameter, and B. 144, killed 12 February, has numerous follicles up to 7 mm. and two corpora lutea, one recent and one older. Ovaries of the third year are all of pregnant animals and are three in number, but the one non-pregnant ovary, B. 142, from a mature seal (fourth year or over) was collected on 27 January and shows fairly numerous follicles with a maximum of 6·5 mm. and four corpora lutea of different ages, the largest being 30 by 18·5 mm. It is a matter for regret that the evidence is not more conclusive, but I do not consider that one may safely go further than to state that it seems highly probable that this species may begin ovulating in its second year, but does not always do so, and that it commonly becomes pregnant in its third year, perhaps for the first time. The third year therefore should be considered as the year of sexual maturity at present.

BREEDING HABITS

As might reasonably be expected from the solitary habit of this animal, information regarding its breeding is scarce. From the previous section it appears that the ovaries of cows killed in the first three months of the year are active, and the only month in which I have seen leopard seals keeping company is February, when as many as three were observed swimming together. Wild's description (1923) of a "fight" when one seal was seen to leap repeatedly from the water to a height of 6 ft. was much more likely to be a record of courtship. The date was 9 February.

The cow, S.S. 1, killed on 18 January had a single corpus luteum and no trace of others, so that this was probably the first ovulation of the season. Bertram's no. 142 of 27 January has four corpora lutea in the two ovaries, the largest being 30 mm. in longest diameter and the other three in different stages of degeneration, and his seal no. 144 has a corpus luteum in each ovary. I consider that it may be safely assumed that the first two months of the year, and perhaps the third as well, are the season of mating, and from the evidence of the ovaries it is highly probable that this species ovulates several times at short intervals. Additional evidence of a rather prolonged mating season is supplied by records of foetuses. On 16 February a foetus of 16 mm. was obtained by the Discovery Committee's staff, and in late February 1921 I found foetuses about 30 mm. Bertram records the following in March and April:

Table IX

Ref. no.	Date	Length (mm.)
1572	9. iii.	78
1451	17. iii.	118
1101	22. iii.	42
1103	22. iii.	77
1461	28. iii.	110
1459	28. iii.	112
354	30. iii.	250
1121	3. iv.	157
1137	30. iv.	360

It will be observed that within nine days there were collected foetuses of 42, 112 and 250 mm., and that for March there is recorded a foetus of 118 mm., nearly three times the length of one secured five days later (no. 1101, 42 mm.), this difference being analogous to that of human foetuses of four and two and a half months.

Records of newly born pups are very scarce. Bruce states that in the South Orkney Islands only one was seen, but not secured, in November; Matthews saw one about 107 cm. in September, and the specimen in the British Museum was killed, according to the label, at Christmas. The extended pupping season implied by these observations is quite in keeping with the prolonged mating season suggested above (January to March). It follows that the period of gestation is about eight months. Since females killed in the mating season do not have milk it is to be presumed that *Hydrurga*, like the other Phocids, has a short period of lactation.

The breeding habits of the leopard seal are comparable with those of *Lobodon*, which mates in the southern autumn and brings forth the young in the following spring, rather than with those of *Macrorhinus*, *Leptonyx* and some of the northern seals which come on heat very rapidly after parturition and have a period of gestation of eleven months or even more, and in this resemble some at least of the Otariidae.

It is interesting to recollect here that in the multiplication of cusps of the teeth *Hydrurga* and *Lobodon* approach one another more nearly than they do to the other southern seals.

COMMERCIAL VALUE

A number of leopard seals are killed annually in South Georgia (Matthews, 1929) but this is only incidental to the killing of the elephant seal, and the number is so small that, coupled with the relatively low oil production of this species, it is a matter of no commercial importance.

I consider that an animal of such scattered distribution and solitary life is most unlikely to be the object of commercial interest, unless indeed its skin became fashionable for some purpose, and that does not seem very likely, since although it is well coloured and marked the hair is stiff and rather thin.

PARASITES

Internal

By the courtesy of Dr H. A. Baylis I am able to publish the following list.

Nematoda:

- *Contracaecum osculatum* (Rud.) = *Ascaris rectangula* (von Linstow, 1907) = *Ascaris stenocephala* Raillet and Henry, 1907.
- *Contracaecum radiatum* (von Linstow, 1907) = *Ascaris falcigera* Raillet and Henry, 1907.
- *Porrocaecum decipiens* (Krabbe, 1878).
- *Anisakis similis* (Baird, 1853).

Cestoda:

- *Diphyllobothrium quadratum* (von Linstow, 1892) = *D. resimum* Raillet and Henry, 1912 = *Dibothriocephalus coatesi* Rennie and Reid, 1912.
- *Phyllobothrium* sp. [*P. delphini* (Bosc, 1802) *fide* Southwell and Walker, 1936].

Acanthocephala:

- *Corynosoma hamanni* (von Linstow, 1892).

External

Siphunculata:

- *Antarctophirus ogmorhini* Enderlein. I am indebted to Miss Theresa Clay of the British Museum for the information that this parasite has been recorded from *Hydrurga* from Victoria Land, Booth Wandel Island and Macquarie Island.

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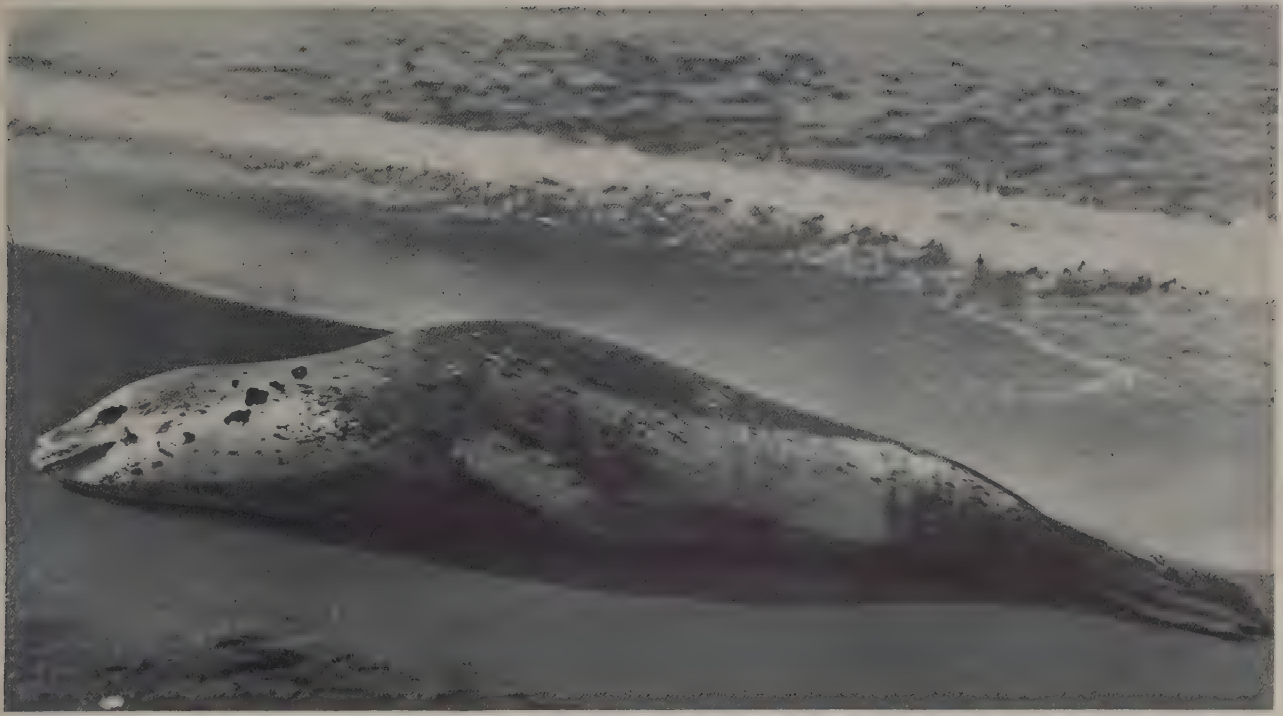
A few additional references will be found in the 'Southern Cross' and 'Scotia' *Reports*.

PLATE VII

Fig. 1. Leopard seal.
Fig. 2. Skin of pup in first coat.



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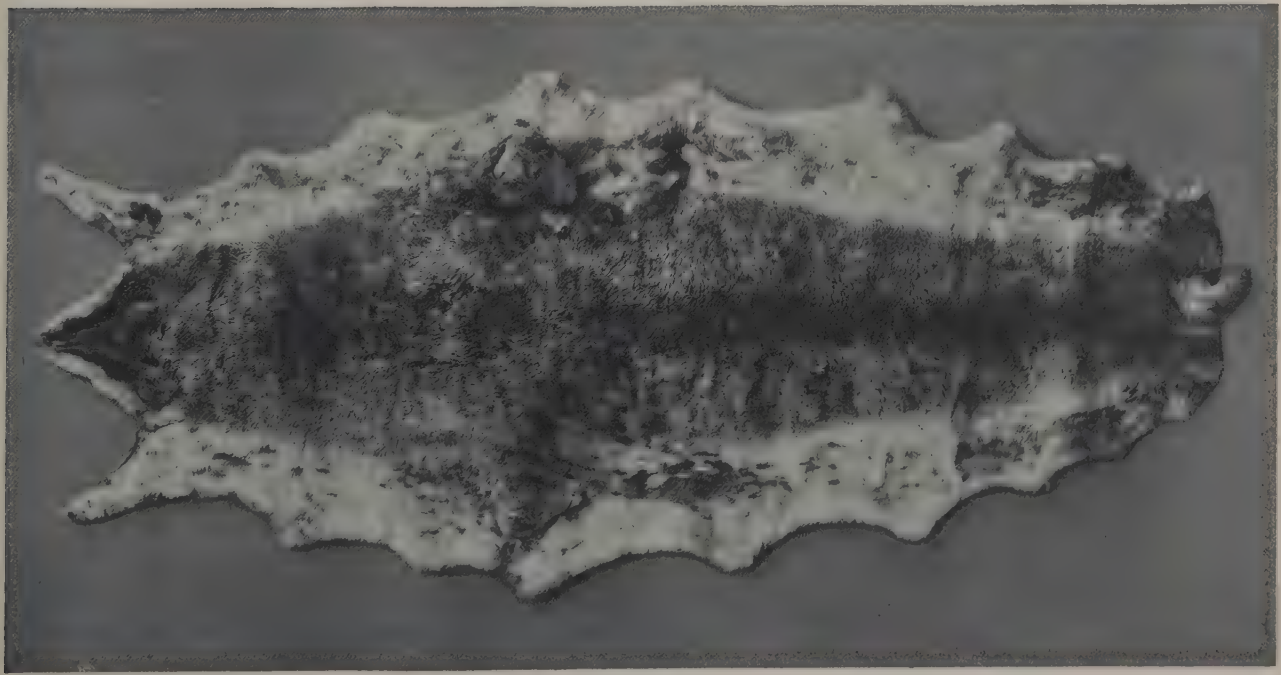

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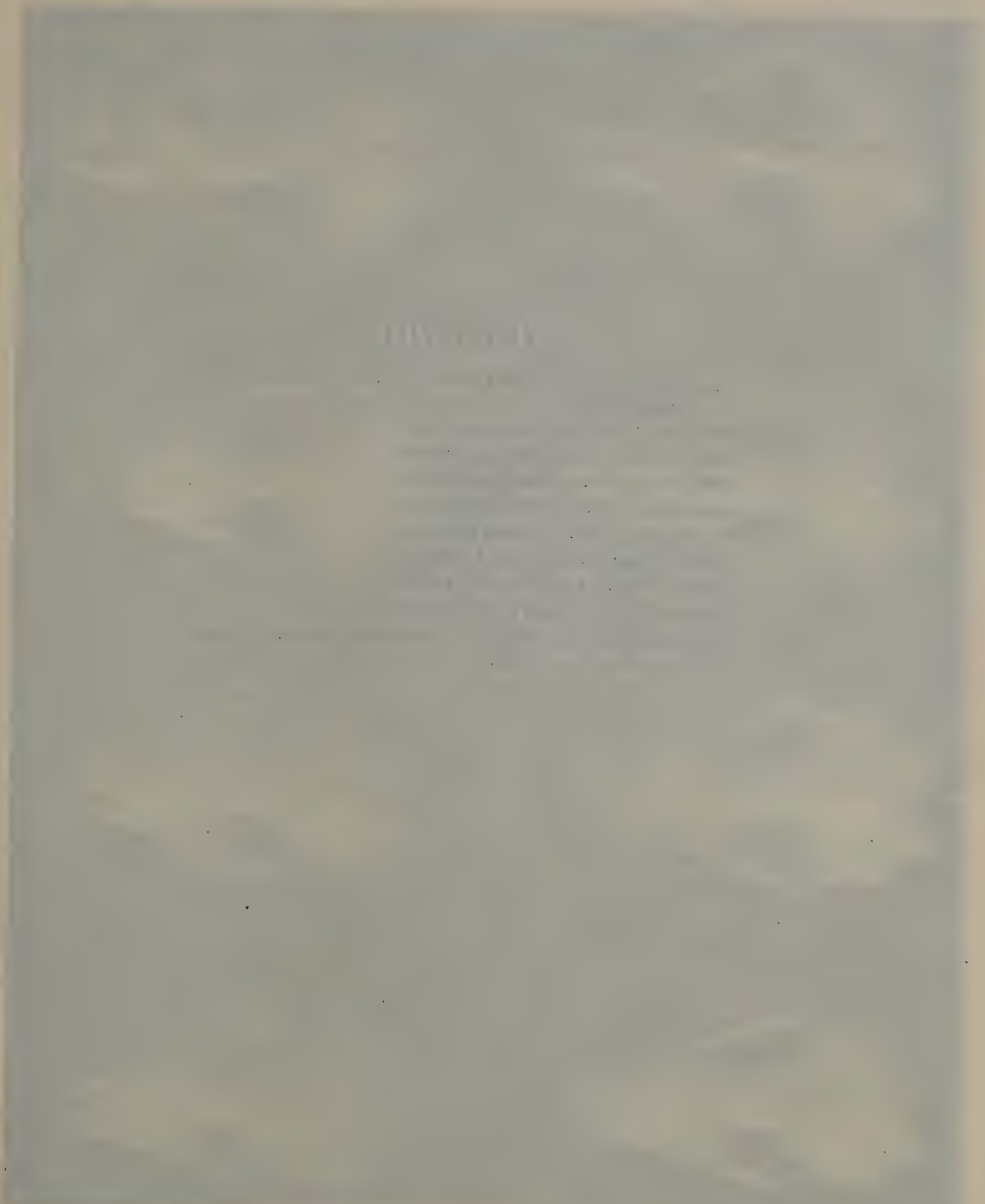

PLATE VIII

Skulls in dorsal view, to show successive growth phases (see pp. 250, 252, 256).

Male. Fig. 1. No. 653. First year group.
Male. Fig. 2. 1.1.4.15. Second year group.
Male. Fig. 3. S.S. 2. Third year group.
Male. Fig. 4. No. 679. Fourth year group.
Female. Fig. 5. No. 663. First year group.
Female. Fig. 6. B. 144. Second year group.
Female. Fig. 7. 325*d*. Third year group.
Female. Fig. 8. B. 145. Fourth year group.

The relative sizes of the skulls are not exactly represented. For dimensions see pp. 251 and 254.

PLATE VIII

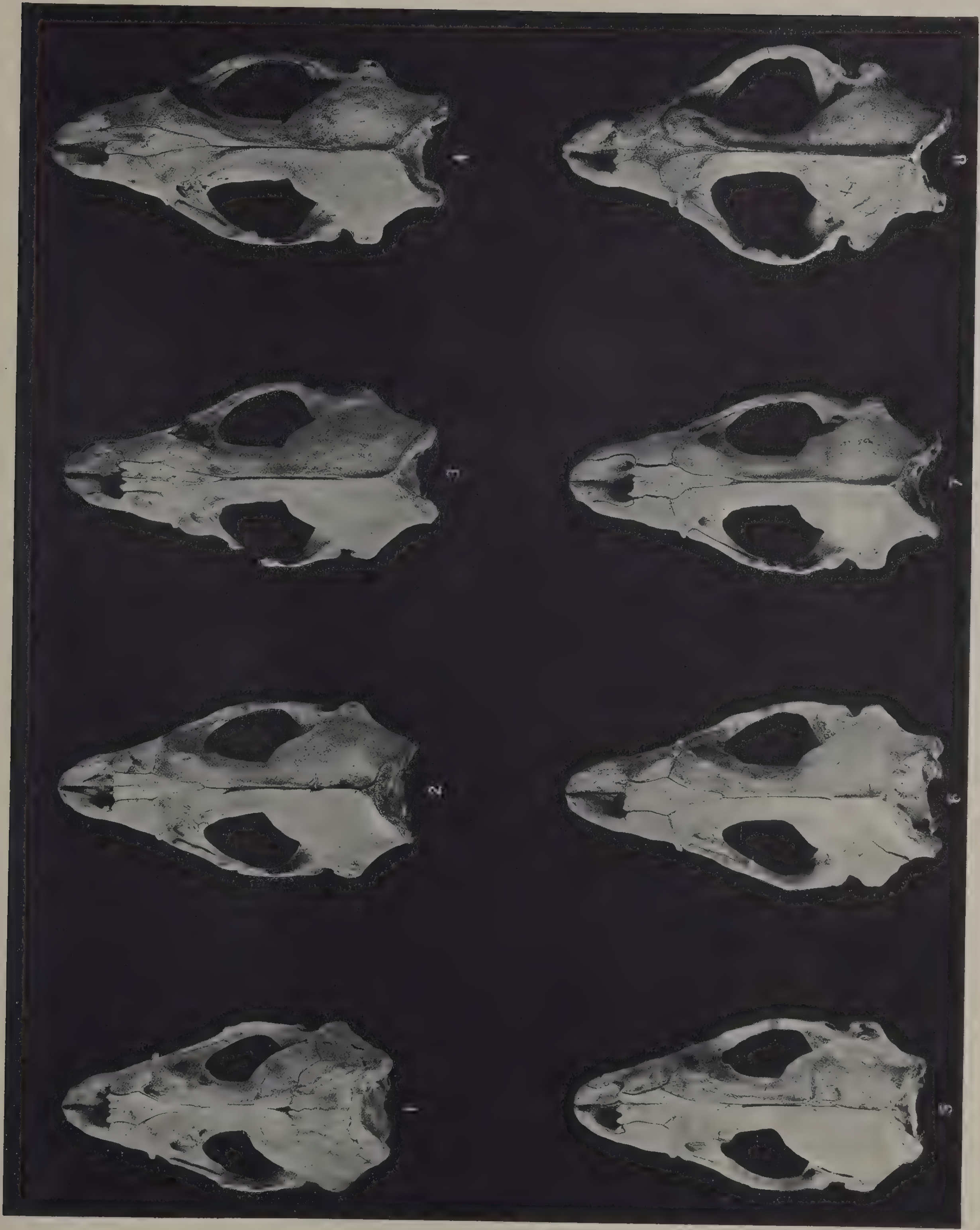

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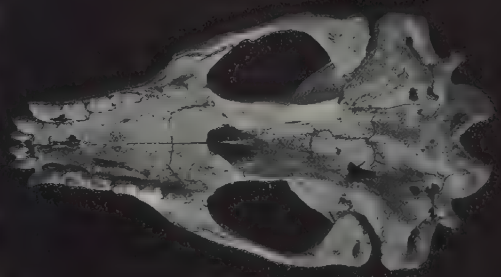
PLATE IX

Skulls in ventral view.

Male. Fig. 1. No. 653. First year group.
Male. Fig. 2. 1.1.4.15. Second year group.
Male. Fig. 3. S.S. 2. Third year group.
Male. Fig. 4. No. 679. Fourth year group.
Female. Fig. 5. No. 663. First year group.
Female. Fig. 6. B. 144. Second year group.
Female. Fig. 7. 325*d.* Third year group.
Female. Fig. 8. B. 145. Fourth year group.

The relative sizes of the skulls are not exactly represented. For dimensions see pp. 251 and 254.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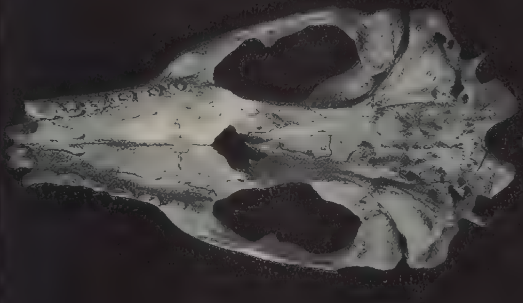
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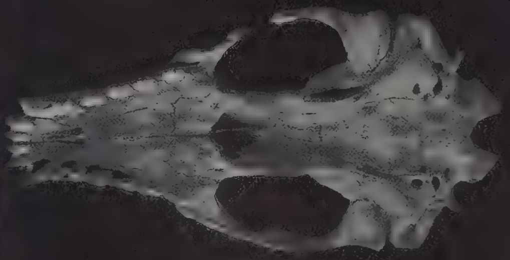
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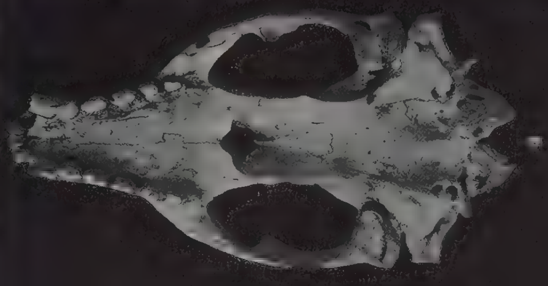
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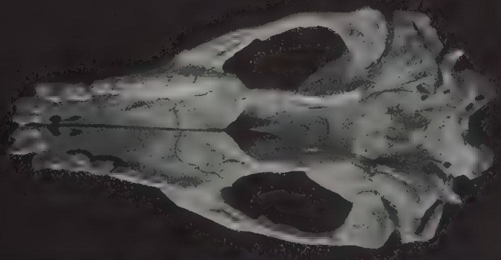
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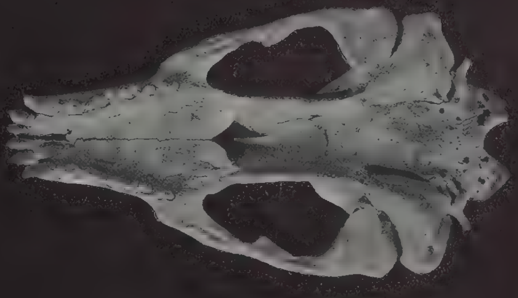
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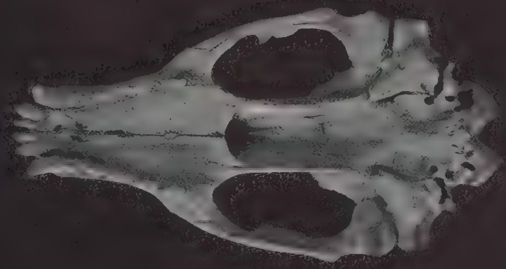
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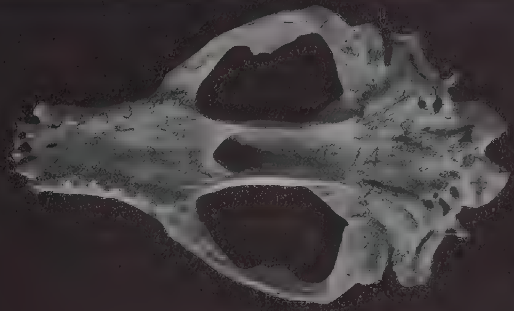
8

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PLATE X

Skulls in lateral view.

Male. Fig. 1. No. 653. First year group.
Male. Fig. 2. 1.1.4.15. Second year group.
Male. Fig. 3. S.S. 2. Third year group.
Male. Fig. 4. No. 679. Fourth year group.
Female. Fig. 5. No. 663. First year group.
Female. Fig. 6. B. 144. Second year group.
Female. Fig. 7. 325*d*. Third year group.
Female. Fig. 8. B. 145. Fourth year group.

The relative sizes of the skulls are not exactly represented. For dimensions see pp. 251 and 254.

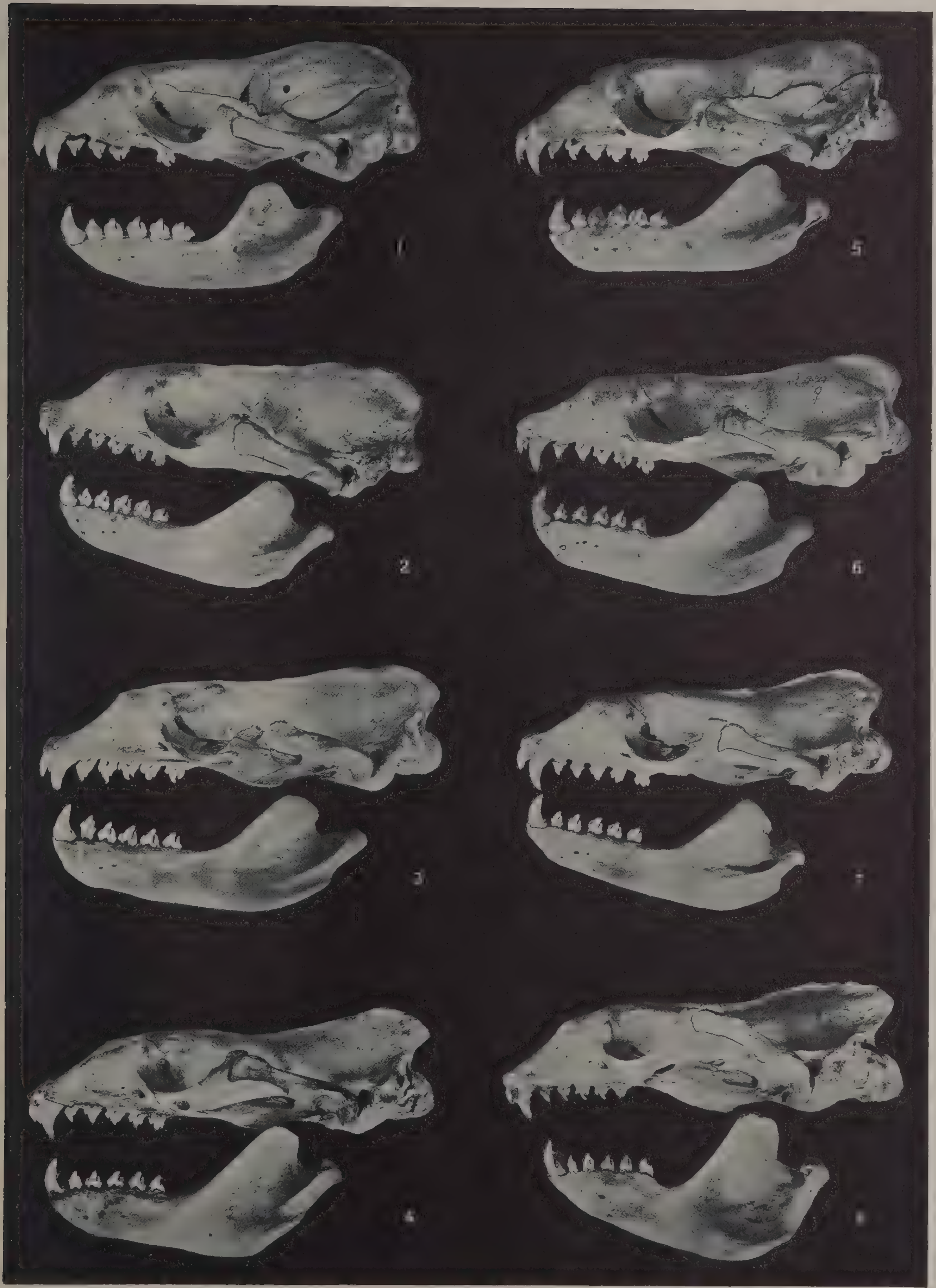

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PLATE XI

Os penis. The numbers are the reference numbers of the animals.

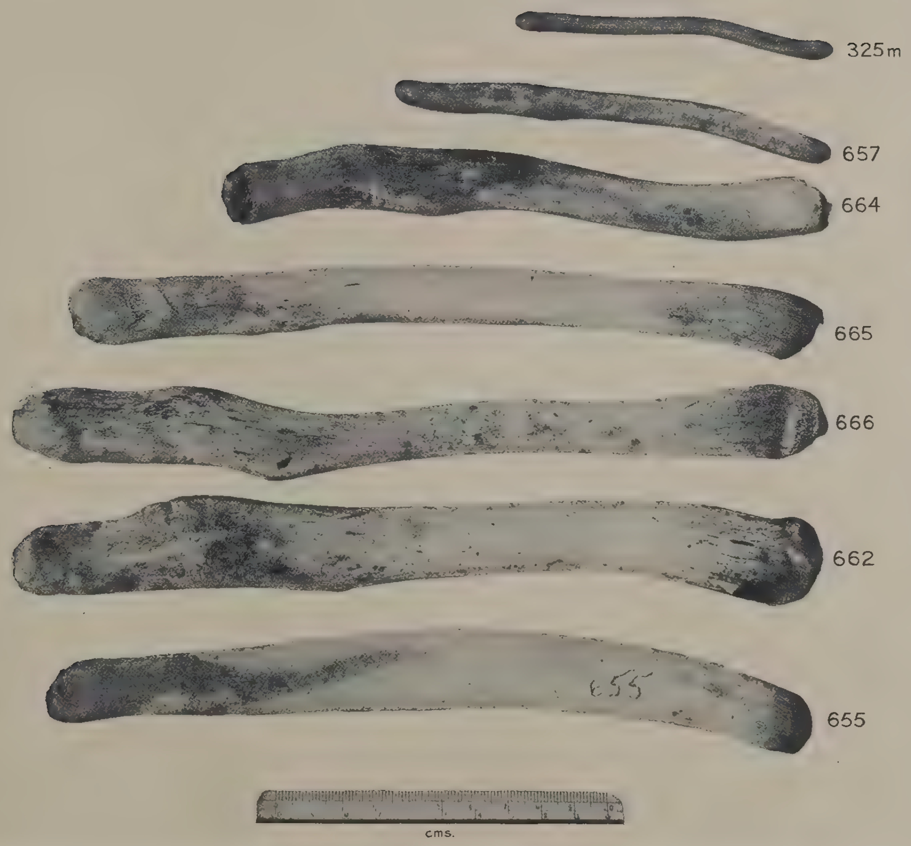
325m
657
664
665
666
662
655
655
cms.

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PLATE XII

Genital organs of female no. 656.

- *a.* Right cornu.
- *b.* Left cornu (opened).
- *c.* Vagina.
- *d.* Urethral tubercle.
- *e.* Vestibule.
- *f.* Clitoris.

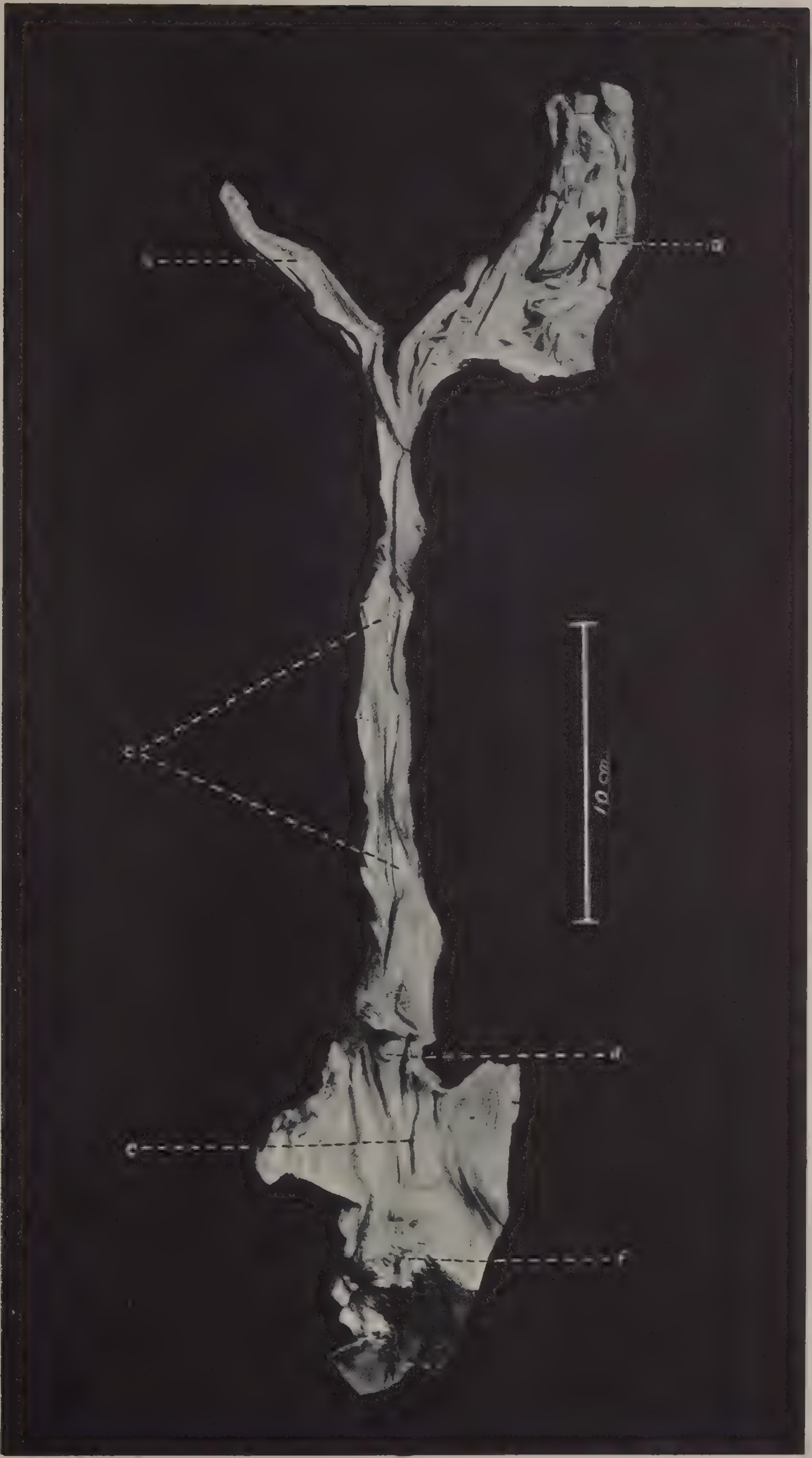
b
a
c
10 cm
d
e
f

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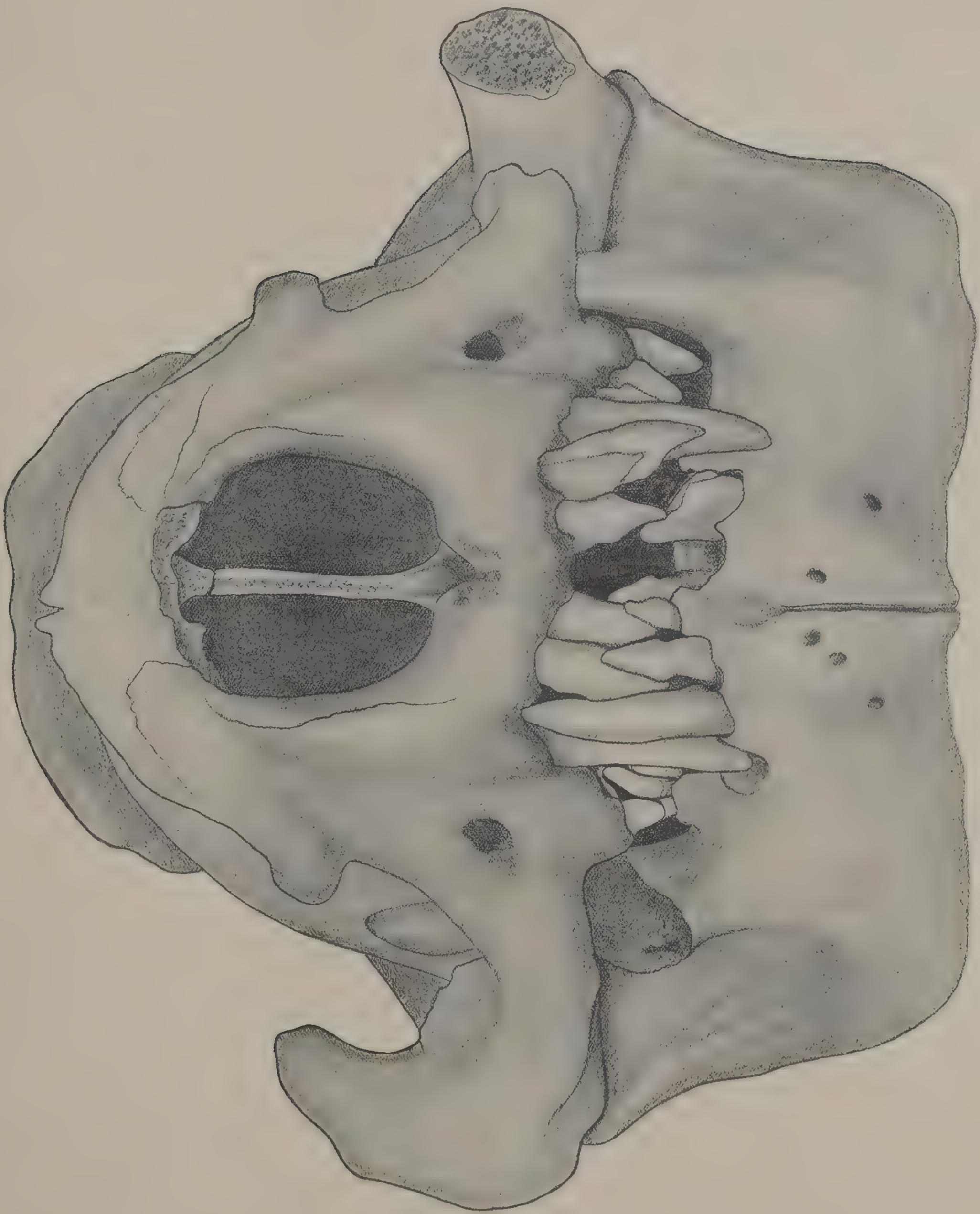
PLATE XIII

Anterior aspect of female skull, R.C.S. 1092, showing displacement of teeth.



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[*Discovery Reports. Vol. XVIII, pp.* 265–322, *Plates XIV–XIX, January* 1940.]

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HYDROMEDUSAE FROM THE FALKLAND ISLANDS

By

(the late) EDWARD T. BROWNE and P. L. KRAMP

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HYDROMEDUSAE FROM THE FALKLAND ISLANDS

By (the late) Edward T. Browne and P. L. Kramp

(Plates XIV–XIX; Text-figs. 1–12)

INTRODUCTION

The Hydromedusae dealt with in the present paper were collected by Mr Rupert Vallentin, who visited the Falkland Islands in November 1898 to February 1899, November 1901 to March 1902, and November 1909 to February 1910. When the first collection was brought to England, it was thoroughly and carefully worked up by Mr E. T. Browne. A complete manuscript, with detailed descriptions of all the species, and numerous beautiful drawings were ready for publication, when Mr Vallentin went out again to the Falklands, and a second collection of Medusae was to be expected the next year. Mr Browne therefore published a preliminary report in the *Annals and Magazine of Natural History* (1902), based upon the first collection, with brief diagnoses of the seventeen species, fifteen of which were new to science. It was Mr Browne's intention to publish a complete report when the second collection had been examined; but this was not to be. When my dear old friend died, on 10 December 1937, the numerous bottles containing the material from Mr Vallentin's second and third voyages were still among his unexamined collections. I am greatly indebted to Dr Stanley Kemp, of the Marine Laboratory at Plymouth, and to Mr M. A. C. Hinton, of the British Museum, for their confidence in placing this most interesting material and Mr Browne's manuscript and drawings in my hands for final examination and publication.

I deeply regret that the final report on the Falkland Medusae was not written by Mr Browne himself in his usual skilful way. In grateful commemoration of a man who contributed so much to our knowledge of those elegant and interesting creatures, the Medusae, and who for many years, since I first met him in 1914, had a considerable influence on my own studies of these animals, I have endeavoured to fulfil this task to the best of my power. He always took great interest in my work, and when I consulted him on certain puzzling problems he readily gave most helpful advice, either by letter or during my repeated visits to his hospitable home at Berkhamsted. I shall always honour the memory of this kind-hearted man and able scientist.

It was my original intention merely to prepare Mr Browne's paper for publication, with such alterations, especially of taxonomy and nomenclature, as had been necessitated by the many years' abeyance, and with the additions derived from the supplementary material. But in spite of the fact that the later collections did not contain any species which were not represented in the first collection, I soon found out that the original plan could not be maintained. The additional material of several species contained developmental stages, young as well as adult, which were not present in the first collection and required description. Moreover, the classification of the Hydromedusae has been much altered since Mr Browne's original manuscript was written (alterations partly introduced by Mr Browne himself in subsequent papers); and studies of the very material at hand gave occasion for several taxonomic considerations which could not easily be omitted, but for which I do not wish the late Mr Browne to take the responsibility. I was much in doubt, therefore, as to the form of the publication, but I am very glad to accept Dr Stanley Kemp's proposal and make it a joint paper under the combined authorship of Mr Browne and myself. I feel the more confident in doing so, because frequent communication and collaboration through many years has given me a fairly intimate knowledge of Mr Browne's views and working methods, which to a great extent he bestowed upon me through the influence he had on my own labour. I feel convinced, therefore, that if we had discussed these matters together, as we used to do, he would most probably have given his approval.

Any attentive reader will easily be able to distinguish between my share in the paper and Mr Browne's. The descriptions of the species are almost entirely Mr Browne's, and I have found very little to alter in them apart from small additions of minor importance. The same applies to the records of the development from the early stages to the adults, except when developmental stages, not present in the first collection, are found and described by me, which will always appear from the accounts of the material following the "specific characters" of each species. I have also included some of Mr Vallentin's interesting notes on specimens observed by him during his second stay at the Falkland Islands. Remarks on the history and distribution of the species and taxonomic discussions based upon literature subsequent to 1902 are written by me. The alterations of nomenclature will appear from a comparison with Mr Browne's preliminary report and from the lists of synonyms. The new species and genera described in the preliminary report have all been maintained.

The most important additions are the following: (i) Only one specimen of *Staurocladia vallentini* was present in the first collection, and since the specimens collected in 1901 differ slightly from the type, a somewhat detailed description of these specimens was necessary; they also gave occasion for a thorough comparison with other species of the same genus. (ii) *Tiara intermedia* is referred to the genus *Halitholus* Hartlaub; Mr Browne once told me that he fully agreed with Hartlaub's revision of the genera of Pandeidae (Tiaridae), and he would certainly have approved my referring the species to that genus; the numerous specimens of this species, in all developmental stages, contained in the second collection, have enabled me to give a thorough account of the development. (iii) *Cosmetirella davisi* is only briefly dealt with, because on a previous occasion (1932) I have given a thorough description of this species, based upon specimens in Mr Browne's collection procured during a visit to Berkhamsted in 1930. (iv) I have been able to describe the young stages and the rate of development of the tentacles in *Phialella falklandica* and *Phialidium simplex*. (v) In *Willia mutabilis* I have given a more detailed description of the tentacles, and I have been fortunate enough to find a few very early stages not seen by Mr Browne; in order to facilitate understanding of the interesting development of this species I have divided the specimens into three groups according to the number of main radial canals, and the description of the development is revised in accordance herewith and considerably augmented. (vi) The tentacles of *Tiaricodon coeruleus* are described somewhat more thoroughly than in the original manuscript.

The species all belong to the order Leptolina, comprising the three suborders Anthomedusae, Leptomedusae and Limnomedusae. The third of these suborders was recently established by me, and before it was published I told Mr Browne about it in a letter, which reached him ten days before his death. The Limnomedusae (Kramp, 1938*a*, p. 107 and 1938*b*, p. 57) originally comprised the two families of Hydromedusae: Moerisiidae (formerly reckoned among the Anthomedusae) and Olindiidae (formerly considered by most authors as belonging to the Trachymedusae). Later on I found (Kramp, 1939, p. 503) that the family Williidae belonged to the same suborder, and in the present paper this much discussed family is placed where in my opinion it belongs. I also found that *Tiaricodon coeruleus* is closely related to *Moerisia* and *Caspionema* and accordingly should be referred to the family Moerisiidae.

The zoogeographical interest of the medusoid fauna of the Falkland Islands and its marvellous resemblance to the medusoid fauna of the British seas had already been emphasized by Mr Browne in his preliminary report (p. 274) and has become even more evident through the increase of our knowledge of related species and their distribution and classification. With very few exceptions the specimens were collected in Stanley Harbour. The material is now in the British Museum (Natural History) in London.

The figures are reproduced from Mr Browne's own beautiful drawings, except those on Plate XIX and the following figures in the text: Fig. 1 (*Phialella falklandica*) and the diagrams Figs. 2, 3, 6*F*, 7*a*, and 7*b* of *Willia mutabilis*.

P. L. KRAMP

COPENHAGEN,
3 *April* 1939

LIST OF SPECIES

ANTHOMEDUSAE

Family CODONIDAE

Sarsia gracilis Browne

Hybocodon unicus (Browne)

Family CLADONEMIDAE

Staurocladia vallentini (Browne)

Family MARGELIDAE

Podocoryne tenuis (Browne)

Rathkea formosissima (Browne)

Bougainvillia macloviana Lesson

Family PANDEIDAE

Halitholus intermedius (Browne)

LEPTOMEDUSAE

Family LAODICEIDAE

Laodicea pulchra Browne

Family MITROCOMIDAE

Cosmetirella davisi (Browne)

Family EUCOPIDAE

Obelia multicia Browne

Obelia sp.

Phialella falklandica Browne

Phialidium simplex Browne

LIMNOMEDUSAE

Family WILLIIDAE

Willia mutabilis Browne

Family MOERISIIDAE

Tiaricodon coeruleus Browne

Family OLINDIIDAE

Aglauropsis conantii Browne

Vallentinia falklandica Browne

SYSTEMATIC ACCOUNT

ANTHOMEDUSAE

Family CODONIDAE

Genus Sarsia Lesson (1843)

Generic characters. Codonidae with four similar, perradial tentacles, basal bulbs each with an abaxial ocellus. Manubrium cylindrical, either within or extending beyond the umbrella cavity. Gonads surrounding the manubrium in a single undivided mass. Exumbrella without longitudinal rows of nematocysts.

Sarsia gracilis Browne (Plate XIV, figs. 1–2; Plate XV, fig. 1).

Sarsia gracilis Browne, 1902, p. 275.
Sarsia gracilis Mayer, 1910, p. 60.

Specific characters. *Adult* (Plate XIV, fig. 1): Umbrella cylindrical, nearly twice as high as broad, with moderately thick walls, and a quadrangular margin. Manubrium a cylindrical tube, about two-thirds of the length of the umbrella cavity. Gonads surround nearly the whole length of the manubrium. Tentacles, four, about twice the length of the umbrella, terminating with a large knob containing nematocysts. Ocellus on the basal bulb of each tentacle. *Colour:* Manubrium, gonads, and basal bulbs of tentacles of a pale yellowish brown. Ocelli bright reddish brown (specimens in formalin). *Size:* Umbrella 5 mm. in height and 3 mm. in width (largest specimen).

The earliest stage: Umbrella bell-shaped, just a little higher than broad. Manubrium a cylindrical tube, about half the length of the umbrella cavity. Tentacles short, with a large terminal cluster of nematocysts. Ocellus at the base of each tentacle. *Colour:* same as adult. *Size:* Umbrella 1 mm. in height and about $\frac{3}{4}$ mm. in width.

Numerous specimens were taken in Stanley Harbour from November 1898 to February 1899 and from November 1901 to March 1902. In addition some specimens were obtained at Port Egremont, 28 October 1909 and at Roy Cove, 1 December 1909.

Among the hydroids collected by Mr Vallentin in Stanley Harbour there is a species of *Syncoryne* bearing medusa buds, some of which are well advanced and nearly ready for liberation. They show the generic characters of the medusoid genus *Sarsia*. Mr Vallentin kept a colony of this *Syncoryne* in an aquarium for a few days and obtained from it a number of free-swimming medusae which he preserved for his collection. It is probable, but there is no absolute proof, that the *Sarsia* liberated from the *Syncoryne* develop into the adult form taken in the tow-net.

The specimens taken in the tow-net form a good series of stages extending from the earliest form up to the adult. The earliest free-swimming form is similar to those liberated from *Syncoryne*, but it is well known that different species of *Syncoryne* liberate medusae so much alike in their earliest stage that, at present, it is not possible to distinguish one species from another with any degree of certainty.

In the earliest stage the umbrella is bell-shaped and the exumbrella is covered with scattered nematocysts. The subumbrella cavity (Plate XIV, fig. 2) is very small owing to the bulging in of the wall of the umbrella, and perradially the wall is nearly cut through by four deep longitudinal grooves which extend to the radial canals, close to the exumbrella. In a transverse section the umbrella cavity is distinctly cross-shaped. The perradial grooves are only just visible in the adult owing to the increase in the thickness of the umbrella wall. As the medusa passes through the intermediate stage a second series of shallow grooves appear, interradially situated. In addition to these longitudinal grooves along the wall of the subumbrella, there are eight adradial ridges in the substance of the umbrella wall.

The gonads extend nearly from the base of the manubrium to the mouth and completely surround the tube-like stomach. The tentacles are rather thin and not of great length; when contracted they are about the same length as the umbrella, but in well-preserved specimens with extended tentacles they may be twice as long. The upper part of the tentacle next the basal bulb is free from nematocysts; beyond this naked portion nematocysts are present in small roundish groups, evenly distributed on all sides of the tentacles; towards the distal end these groups are confluent, forming transverse bands gradually increasing in breadth, and in the extreme portion of the tentacle they often form complete rings, especially in younger individuals; the number of complete rings of nematocysts is very variable, but seldom exceeds five or seven. The free end of the tentacle terminates in a large round knob, full of nematocysts (Plate XV, fig. 1). The basal bulb of the tentacles is small, and a moderate-sized roundish ocellus is situated on the outer side close to the exumbrella.

The velum is very broad and has a small circular opening.

REMARKS. Mayer (1910, p. 60) indicates the possibility of *Sarsia gracilis* being a young *Slabberia*; as, however, several of the specimens from the Falkland Islands are sexually mature, this supposition cannot hold good. The genus *Slabberia* is characterized by the gonads forming two or more separate rings around the manubrium.

The most characteristic feature of *Sarsia gracilis* is the presence of a prominent knob of nematocysts in the terminal end of each tentacle; a similar structure is found in the following species of *Sarsia*: (i) *S. coccometra* Bigelow (1909, p. 179, pl. 7, fig. 8; pl. 40, fig. 1; pl. 43, figs. 8–9), from the Pacific coast of Central America, is about the same size as *S. gracilis*, the umbrella has a large, pointed apical projection, the manubrium is very broad and thick, and above the terminal knob (which is not very prominent) the nematocysts form complete rings throughout the whole length of the tentacle. (ii) *S. inabai* Uchida (1933, p. 126, fig. 2) from Kamtchatka has very short tentacles with an egg-shaped terminal knob but no other groups of nematocysts. (iii) *S. nipponica* Uchida (1927, p. 183, pl. 10, fig. 1) from Kishu, Japan, seems to be the species nearest related to *S. gracilis*; it is much smaller, only 1·2 mm. high, and fairly broad in proportion to its height; the tentacles are short and have only six or seven groups of nematocysts. The common European *S. gemmifera* Forbes is distinguished from all these species by its very long and thin manubrium, from which budding of medusae takes place.

Genus Hybocodon L. Agassiz (1862)

GENERIC CHARACTERS. Codonidae with a single tentacle or a single group of two or more tentacles, perradially situated, and three rudimentary perradial basal bulbs without tentacles. Margin of the umbrella not at right angles to the longitudinal axis of the umbrella, but sloping towards the side carrying the tentacle or group of tentacles.

Hybocodon unicus (Browne) (Plate XV, figs. 2–3).

Amphicodon unicus Browne, 1902, p. 276.
Hybocodon unicus Mayer, 1910, p. 42.

SPECIFIC CHARACTERS. *Adult* (Plate XV, fig. 2): Umbrella bell-shaped, a little higher than broad. Manubrium cylindrical and nearly as long as the umbrella cavity. Gonads surround the tube-like manubrium and extend from near the base of the manubrium to close to the mouth. One solitary tentacle, situated between two rudimentary basal bulbs; three perradial bulbs without tentacles. *Colour:* Gonads and basal bulbs of a pale yellowish brown (specimen in formalin). *Size:* Umbrella 3 mm. in height and 2 mm. in width.

The collection contains only one single specimen taken in Stanley Harbour on 20 November 1898.

The umbrella has fairly thin walls and a narrow velum. The diameter of the ring canal is much smaller than the maximum diameter of the umbrella. The exumbrella is covered with scattered nematocysts, which are not arranged in longitudinal rows. The margin of the umbrella is slightly oblique, so that the side of the umbrella bearing the tentacle is longer than the opposite side. The manubrium has a small apical knob and a small apical stalk, the remains of the umbilical canal which originally connected the medusa to its hydroid. The proximal part of the manubrium, free of gonads, consists of large vacuolated cells (as in *Hybocodon prolifer*). The solitary tentacle is situated on a very small bulb, which is placed between two large rudimentary basal bulbs containing nematocysts, but not bearing tentacles (Plate XV, fig. 3). In *H. prolifer* there is at first a solitary tentacle, and later on two more tentacles appear, one on each side of the primary tentacle; in the Falkland specimen the two rudimentary bulbs mark their position. The other rudimentary perradial bulbs are very small and have a long tapering process which is attached to and curls over the margin of the umbrella. The three rudimentary perradial bulbs as well as the two large nematocyst pads flanking the solitary tentacle resemble the corresponding structures in *H. prolifer*, but are not continued upwards on the exumbrella as lines of nematocysts. The tentacle is long; in the present specimen it is coiled into a close spiral and so much contracted that the arrangement of its nematocysts can only be seen by a closer examination; the nematocysts form complete rings around the tentacle just as in *H. prolifer* and other medusae of the same group (*Euphysa*, *Steenstrupia*).

Family CLADONEMIDAE

Genus Staurocladia Hartlaub (1917)

Syn. *Cnidonema* Gilchrist, 1919.

GENERIC CHARACTERS. Cladonemidae adapted for crawling or walking. No brood pouch above stomach. Gonads well developed, in ectodermal interradial pockets around stomach. Sexes separate. Radial canals usually six. Tentacles numerous, increasing with age, and not corresponding to number of radial canals, dichotomous; the upper branch with several clusters of nematocysts in addition to a terminal cluster. No oral tentacles. Thick nematocyst ring under margin of bell.

The above diagnosis is derived from Gilchrist (1919, p. 525) who established the genus *Cnidonema* for the reception of his new species, *C. capensis* "and probably all the other southern *Eleutheria*" (i.e. *vallentini* Browne, 1902; *charcoti* Bedot, 1908; *hodgsoni* Browne, 1910; and *kerguelensis* Gilchrist, 1919), and he was undoubtedly right in separating these species from the old genus *Eleutheria* Quatrefages (1842). The generic name must, however, be *Staurocladia* which was established by Hartlaub (1917, p. 401), with *S. vallentini* (Browne) as its genotype. Hartlaub also "provisionally" placed *Eleutheria claparedei* Hartlaub in his new genus; this was a mistake, but the fact remains that *E. vallentini* Browne was made the genotype of a new genus, *Staurocladia*, which must stay as the generic name. Hartlaub's diagnosis of the genus was as follows: "Kleine, *Eleutheria*-ähnliche Cladonemiden von kriechender Lebensweise; keine dorsale Bruthöhle; Gonade ringförmig am Manubrium; getrennt geschlechtlich." The number and the structure of the tentacles are not included in this diagnosis, but in other respects it corresponds with the diagnosis of *Cnidonema* as given by Gilchrist. The genus *Eleutheria* Quatrefages, comprising the two European species *E. dichotoma* Quatrefages and *E. claparedei* Hartlaub, is distinguished from *Staurocladia* by the following characters: brood pouch present above stomach; gonads reduced, lodged in brood pouch; hermaphrodite; tentacles of the same number as radial canals, dichotomous, upper branch with only one, terminal, nematocyst cluster (Gilchrist, 1919).

The history of the genera *Eleutheria* Quatrefages, *Cladonema* Dujardin, and *Staurocladia* Hartlaub (= *Cnidonema* Gilchrist) has been dealt with by several authors, mainly by Gilchrist (1919, p. 518), Briggs (1920, p. 93), Lengerich (1922 *a* and *b*, who united them all into one genus, *Eleutheria*), and Weill (1937, p. 281), and need not be repeated here. Ten species of *Staurocladia* have been described; their limitations are more or less doubtful and are discussed below.

Staurocladia vallentini (Browne) (Plate XIV, figs. 3–4; Plate XV, fig. 4; Plate XIX, fig. 2).

Eleutheria vallentini Browne, 1902, p. 279.
Staurocladia vallentini Hartlaub, 1917, p. 401.
Cnidonema vallentini Gilchrist, 1919, p. 526.

Description of the type specimen (Plate XIV, figs. 3–4). Umbrella circular, about twice as broad as high. Stomach tube conical and small. Mouth without lips, a plain round margin. Gonads occupying the whole of the upper part of the umbrella, above and around the stomach. Tentacles twenty-four, divided into two branches: the upper branch with clusters of nematocysts, the lower with a terminal adhesive disk. An ocellus on the extreme margin of the umbrella, opposite each tentacle. *Colour:* "The whole medusa was pure white in colour, with the exception of the bases of the tentacles which were tinged with red" (note on the living specimen by R. Vallentin). Ocelli reddish brown (in formalin). *Size of living specimen:* umbrella 3 mm. in width and 2 mm. in height (according to Vallentin).

A single specimen was found on a frond of *Macrocystis*, commonly called kelp, in Stanley Harbour, about 1 fathom below the surface on 6 December 1898.

The specimen in formalin is not quite so large as the dimensions given by Mr Vallentin, and the colour is no longer pure white, but rather pale yellow. The clusters of nematocysts are decidedly yellow. The tentacles are figured somewhat diagrammatically, owing to their distorted positions in the preserved specimen, which has only twenty-one tentacles. A vacant space suggested that the margin of the umbrella has been damaged and that at least two tentacles were missing. Two tentacles were added in the figure to fill up this gap and to give a more natural appearance to the medusa. After the drawing was finished, it was found that Mr Vallentin had carefully examined this medusa whilst alive and had made some notes upon it. He records that the medusa has twenty-four tentacles, so that the figure is one short in number. The arm of the tentacle bearing the nematocysts is uppermost, and has usually two or three clusters on the upper side and occasionally a cluster on the lower side; there is always a terminal cluster forming a knob (Plate XV, fig. 4). The number of clusters varies from one to three, exclusive of the terminal cluster. The size of the clusters indicates that at first only one cluster is present, the terminal one, and the other ones appear later, the oldest being nearest the terminal cluster. The lower branch or arm with the adhesive disk is without nematocysts.

There are also two minute bulbs on the margin of the umbrella, nearly opposite each other. These bulbs may be either the commencement of other tentacles, or rudimentary medusa buds. The radial canals are quite invisible owing to the opaqueness of the body.

Note by R. Vallentin: "The medusa is able to progress through the water at a fairly respectable pace by means of its tentacles which open and close simultaneously. It swims very much like *Gonactinia prolifera*, the budding anemone."

On 2 December 1901 Mr Vallentin collected some more specimens of this medusa. In his notes he writes as follows: "Colour of living animal on dark background: body, gonads, stomach, and arms pellucid. Eyes reddish brown. Diameter of living animal when walking 5 mm. including tentacles, body 1 mm. excluding tentacles. No medusa-buds observed on any of the specimens. The animal, when walking, keeps the hollow tentacles waving about in the water, the tentacles with suckers being closely applied to the side of the jar of sea-water in which it is confined. These ambulatory gonozooids appear to live on a fine weed[1] which is uniformly spread over the bottom of the harbour in Whale Sound. There is no mud in this region, only fine sand. The gonozooids are always on the move, crawling in and out the fine filaments and twisting themselves into the most peculiar shapes as they slowly progress through the miniature tangled forest."

This new collection consists of eighteen specimens, preserved in 90% alcohol. Some few specimens are well preserved, but most of them are more or less damaged and have lost several or all of their tentacles. They were found in about the same locality and at the same season as the type specimen, but on another species of alga. In the structure of the tentacles they differ slightly from the type.

A re-examination of the type specimen shows that the original description and drawings are correct in every detail. In the type the lower branch of the tentacles with the adhesive disk is only slightly longer than the upper branch with the clusters of nematocysts. In the specimens obtained in 1901 the difference in length of the two branches is almost always considerably larger. This may to some extent be due to different states of contraction; but even in tentacles, in which the upper branch seems to be extended to about the same degree as in the type, the lower branch is usually twice, sometimes even three times, as long as the upper branch; in a few specimens, however, the two branches differ only very slightly in length. The relative length of the branches therefore seems to be subject to some variation independent of the state of contraction.

In the type a cluster of nematocysts is occasionally present on the lower side of the upper branch of the tentacles, but in most of the tentacles nematocyst clusters are only found on the upper side, one to three in number (exclusive of the terminal cluster). In the specimens taken in 1901 the lower side is always provided with clusters of nematocysts, except in very young tentacles with only one cluster on the upper side. In fully developed tentacles the usual number is three on the upper side and two on the lower side, alternately placed. Sometimes a third very small cluster is observed on the lower side, and in a few tentacles a fourth cluster is added on the upper side of the branch, close to its base (Plate XIX, fig. 2). According to the stage of development of the tentacle the number of nematocyst clusters (excluding the terminal one) are: 1/0, 1/1, 2/1, 2/2, 3/2, 3/3, 4/3. In one exception the number was 3/1, but 2/0 or 3/0 has not been observed in any of these specimens, whereas it is the rule in the type specimen. For comparison with other species of *Staurocladia* it should be emphasized that the position of the nematocyst clusters is decidedly median (on the upper and lower side) without the slightest indication of a lateral position. Each cluster of nematocysts is crescent-shaped, thick in the middle, tapering towards both sides, clasping around about one-third of the circumference of the tentacle when fully developed; young clusters are circular in outline; the terminal cluster is spherical.

REMARKS ON THE SPECIMENS. (1) Diameter of the umbrella 1·45 mm., tentacles 1·45 mm. long, number of tentacles about twenty-four. (2) Diameter 1·35 mm., tentacles 1·45 mm. (most of them lost), basal part of tentacle about 0·45 mm., lower branch 1·0 mm., upper branch 0·45–0·6 mm. (3) Diameter 1·2 mm., tentacles 1·1 mm., twenty-three or twenty-four in number. (4) Diameter 1·15 mm., tentacles 1·35 mm., twenty-two or twenty-four in number. (5) Diameter 0·8 mm., tentacles 0·9 mm., seventeen in number; four of the tentacles are smaller (younger) than the others, the smallest being 0·15 mm. in length, divided into two branches, the upper branch with a small terminal cluster of nematocysts; the other young tentacles are in intermediate stages. (6) Diameter 0·8 mm., tentacles 1·0 mm., fifteen or sixteen tentacles, four of which are smaller than the others; moreover, there are, on the margin of the umbrella, three minute knobs, each of which is placed between two fully developed tentacles; they are undoubtedly rudiments of tentacles in their very first stages of development; there is no reason to believe that they are young medusa buds. In this specimen six radial canals can be faintly traced. The remaining specimens have lost almost all their tentacles; two of them have been stained in paracarmine and examined anatomically; they both have seven radial canals.

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[1] *Sphacelaria* sp., kindly identified by Dr H. E. Petersen, Copenhagen.

As in the type specimen, the maximum number of tentacles in the specimens taken in 1901 is about twenty-four. When young tentacles are present, they are of different sizes, and they are placed at irregular intervals on the umbrella margin.

There is no indication of medusa buds being developed in any of the specimens from the Falkland Islands.

COMPARISON WITH OTHER SPECIES. The following species of *Staurocladia* have been described:

S. vallentini (*Eleutheria vallentini* Browne, 1902). Falkland Islands.

S. charcoti (*Wandelia charcoti* Bedot, 1908, *Eleutheria charcoti* Browne, 1910, p. 26). Wandel Island, Graham Land, Antarctic.

S. hodgsoni (*Eleutheria hodgsoni* Browne, 1910, p. 28). McMurdo Sound, Antarctic.

S. kerguelensis (*Eleutheria vallentini* Vanhöffen, 1911, p. 201 and 1912*a*, p. 357; *Cnidonema kerguelensis* Gilchrist, 1919, p. 521). Kerguelen Island.

S. capensis (*Cnidonema capensis* Gilchrist, 1919, p. 509). Cape of Good Hope.

S. haswelli (*Cnidonema haswelli* Briggs, 1920, p. 97). Port Jackson, Australia.

S. oahuensis, *bilateralis*, *acuminata*, and *alternata* (Edmondson, 1930). Hawaii.

These species are distinguished by various characters of more or less doubtful taxonomic value. The internal anatomy has been studied in *S. kerguelensis* (by Müller, 1911, Taf. III, fig. 4, Vanhöffen, 1911, text-figs. 5*a*, 5*c*, and by Lengerich, 1920, figs. 6–10, and 1922*b*, figs. N 1–Q 1), *capensis* (by Gilchrist, 1919, pl. 30, figs. 3–7), and *haswelli* (by Briggs, 1920, pl. 17, figs. 2–4; pl. 18, figs. 1–5). An examination of the specimens taken at the Falkland Islands in 1900 shows that the anatomy of *S. vallentini* agrees perfectly with that of the other species as described and figured by these authors. The gonads surround the stomach in the same manner and are not restricted to its aboral part, which, according to Gilchrist, was supposed to be the main feature distinguishing *S. vallentini* from *capensis*.

S. charcoti was characterized by the radial canals being provided with slender lateral branches with a tendency towards anastomosis. Vanhöffen and Lengerich, however, observed a similar branching of the canals in undissected specimens of *S. kerguelensis*, but were unable to see any branches in sections; they were inclined to think, therefore, that the apparent branching of the radial canals was due to misinterpretation in both cases.

The most characteristic feature of *S. hodgsoni* is the absence of a continuous ring of nematocysts below the umbrella margin, the ring being divided into isolated patches of nematocysts on the basal portion of the tentacles. According to Lengerich (1922*b*, p. 353) the nematocyst ring assumes a similar appearance in strongly contracted specimens of *S. kerguelensis*. It is, however, rather improbable that the apparent absence of a complete ring in *S. hodgsoni* could be explained in a similar way, since the description and figures of that species are based on six well-preserved specimens. A re-examination of the type specimens is necessary to decide this question.

Gilchrist as well as Briggs divided the species known up to 1920 into two groups according to the position of the clusters of nematocysts on the upper branch of the tentacles. In *S. charcoti*, *hodgsoni*, and *kerguelensis* the clusters of nematocysts (excluding the terminal one) are placed on the lateral sides of the tentacle, whereas in *S. vallentini*, *capensis*, and *haswelli* they are median in position, placed on the upper (aboral) and lower (oral) sides of the tentacle. Gilchrist and Briggs both emphasize that the median (oral and aboral) position of the clusters of nematocysts was constant in all the numerous specimens of *S. capensis* and *haswelli* examined by them, and in the specimens of *S. vallentini* collected at the Falkland Islands in 1901 the position of the clusters is likewise found to be constant. The lateral position seems to be equally constant in *S. charcoti*, *hodgsoni* and *kerguelensis*, so that there is every reason to suppose that the position of the clusters of nematocysts is a suitable character for the distinction of species in this genus. In the four species from Hawaii described by Edmondson (1930) the position of the clusters of nematocysts is very peculiar. In *S. oahuensis* they are confined to the upper (aboral) side of the tentacles; in *S. alternata* they are likewise placed on the upper side, but in two alternating rows; in *S. bilateralis* there is one cluster on the upper side and two on the lateral sides, and in *S. acuminata* there are two on the upper side, one on the lower side, and one on each of the lateral sides. This might seem to diminish the taxonomic value of this character, but the absolute consistency, pointed out above, in the arrangement of the nematocyst clusters in each of the southern species must lead to the conclusion that *S. charcoti*, *hodgsoni*, and *kerguelensis* are specifically distinct from *S. vallentini*, *capensis*, and *haswelli*.

The three last mentioned species are evidently closely related and are only distinguished from each other by characters which are variable in all of them. The number of radial canals is six to seven in *S. vallentini*, six in *capensis*, eight (sometimes six or seven) in *haswelli*. In *S. vallentini* the number of tentacles does not seem to exceed twenty-four; in *S. capensis* "the number of tentacles varies very considerably, from six in the youngest to about forty in the largest"; the largest specimen of *S. haswelli* had thirty-one tentacles. The largest number of nematocyst clusters on the tentacles was: in *S. haswelli* 2/1, in *capensis* 2/1 or 3/1; in the type specimen of *vallentini* 3/0 or 3/1, in the specimens taken in 1901 usually 3/2. The relative length of the two branches of the tentacles seems to distinguish *S. capensis* from the other species; it is, however, dependent on the age of the individuals and on the state of contraction, and it is evidently also subject to individual variation. In *S. capensis* the upper branch, when fully extended, is about three times the length of the lower branch, but in a contracted condition the two branches are of about equal length. In *S. haswelli* the upper branch is shorter than the lower; the difference in length is considerable in young specimens, but very slight in the adults. In *S. vallentini* the upper branch is likewise shorter than the lower branch; the variations are mentioned above.

Asexual reproduction by medusa buds is observed in young specimens of *S. capensis*, and Briggs also records one case of very young buds being observed in a specimen of *S. haswelli*. In *S. vallentini* medusa buds have not yet been observed with certainty.

Future investigations of more extensive material from various localities will probably prove that *S. capensis* (Gilchrist) and *S. haswelli* (Briggs) are identical with *S. vallentini* (Browne). As pointed out above there are, however, certain characteristic differences between these three species (the great length of the upper tentacle-branch in *S. capensis*, the apparently limited number of tentacles in *S. vallentini*), which make one hesitate to unite them in the present state of our knowledge.

S. vallentini and its two nearest relatives all belong to the southern seas (Falkland Islands, South Africa, and Australia). A closely related medusa is, however, described from Bermuda by Weill (1937, p. 281) under the name of *Eleutheria* (*Cnidonema*) *vallentini*. It is highly probable that the identification is correct, but as only one very young specimen (with medusa buds) was found its affinities cannot be stated with certainty. This record, in conjunction with the four species from Hawaii, appears to indicate that the distribution of the genus *Staurocladia* is not restricted to the southern hemisphere.

Family MARGELIDAE

Genus **Podocoryne** M. Sars (1846)

Generic characters. Margelidae with four or more simple marginal tentacles which arise separately, not in clusters; the four corners of the mouth drawn out so as to form four oral arms, simple or dichotomously branched, with terminal clusters of nematocysts.

Mayer (1910, p. 135) gives reasons for applying the name of *Podocoryne* Sars to this genus and to relinquish *Dysmorphosa* Philippi, 1842. Several species formerly referred to *Podocoryne* or *Dysmorphosa* belong to the genus *Lizzia* Forbes, 1848, which is distinguished from *Podocoryne* by the possession of true oral tentacles arising from the sides of the mouth tube some distance above the mouth opening, whereas the oral arms of *Podocoryne* are dilatations of the corners of the mouth itself, armed with clusters of nematocysts. In *Podocoryne* the marginal tentacles always arise separately from the umbrella margin, but in some species of *Lizzia* the perradial marginal bulbs carry two or more tentacles. In both genera there are species which have asexual reproduction, forming medusa buds upon the sides of the manubrium, and other species which do not produce medusa buds.

Podocoryne tenuis (Browne) (Plate XV, figs. 5–6).

Dysmorphosa tenuis Browne, 1902, p. 277.
Podocoryne tenuis Mayer, 1910, p. 141.
Podocoryne tenuis Kramp, 1928, p. 47.

SPECIFIC CHARACTERS (Plate XV, fig. 5). Umbrella somewhat conical with a slight constriction above the subumbrella cavity; a little higher than broad. Stomach cubical, and on a gelatinous peduncle about as long as itself. Mouth with four lips having terminal clusters of nematocysts. Medusa buds upon the stomach, interradially situated. Tentacles eight. *Colour:* Stomach, medusa buds, and basal bulbs of tentacles pale yellow (in formalin). *Size:* Umbrella 2 mm. in height and 1½ mm. in width.

Two specimens were taken in Stanley Harbour in November 1898; from Vallentin's second voyage there is only one specimen (date of capture not stated); the third collection contains six specimens, taken in Roy Cove 23 November and 1 December 1909 and in another locality at the Falkland Islands 19 January 1910.

The two specimens from November and December 1909 are evidently young individuals which have not yet developed medusa buds; they are only 0·7–1·2 mm. high, and the smallest one has very thin walls and no apical gelatinous crown. The other specimens all have medusa buds upon the interradial sides of the stomach, and gonads are not visible. Some of these specimens have only four medusa buds placed in one whorl, but in three specimens from January 1910 four minute medusa buds are seen forming a second whorl below the four large buds.

In most specimens the umbrella has a solid mass of jelly above the umbrella cavity. The velum is fairly broad. The tentacles on the margin of the umbrella are of equal size and have small basal bulbs.

The mouth, when contracted, has four short lips, each of which has a large cluster of nematocysts; the stomach cavity is cross-shaped, and a narrow groove proceeds along the inner side of the lips. When expanded the mouth is quadrangular (Plate XV, fig. 6), and the clusters of nematocysts are clearly visible in the four corners.

Other species of *Podocoryne* with medusa buds are (i) *P. minima* (Trinci, 1903) from Naples, a very small medusa, 0·27–0·33 mm. high, with only four marginal tentacles; (ii) *P. simplex* Kramp (1928) about 0·75 mm. high and likewise with only four tentacles, two of which are much smaller than the others; (iii) *P. meteoris* Thiel (1938) from Cape Verde with eight marginal and twelve oral tentacles; it is most probably a *Lizzia*; (iv) *Podocoryne minuta* Mayer (1900) from Florida (Mayer, 1900, p. 41, pl. 18, fig. 42) and from Great Fishbay on the west coast of Africa (Thiel, 1938, p. 298) [records of the same species from the Mediterranean (Trinci, 1904; Neppi and Stiasny, 1913) are doubtful]. *P. minuta* bears a great resemblance to *P. tenuis*, and it is possible that the two species are identical; *P. minuta* is, however, much smaller, only 0·3 mm. high, whereas *P. tenuis* attains a height of 2 mm.; provisionally, therefore, it will be advisable to regard them as separate species.

Genus Rathkea Brandt (1837)

GENERIC CHARACTERS. Margelidae with marginal tentacles arranged in eight groups (four perradial and four interradial); the four corners of the mouth drawn out so as to form four oral arms with clusters of nematocysts.

Rathkea formosissima (Browne) (Plate XIV, fig. 5; Plate XIX, fig. 1)

Lizzia formosissima Browne, 1902, p. 278.
Rathkea formosissima Mayer, 1910, p. 177.
Lizzia formosissima Hartlaub, 1911, p. 144.

SPECIFIC CHARACTERS. *Adult:* Umbrella bell-shaped, a little higher than broad, with a slight transverse constriction level with the top of the subumbrella cavity and a solid mass of jelly above it. Stomach small, somewhat cubical, about as long as broad, and situated on a broad peduncle about as long as the stomach. Mouth with a plain simple margin, quadrangular in shape; oral arms four, each with seven to eleven clusters of nematocysts arranged in a double row with always a single terminal cluster. Gonads on the stomach, four interradial roundish swellings or masses. Medusa buds may be present on the stomach, interradially situated. Tentacles, five in each perradial group and three in each interradial group. *Colour:* Stomach brownish; compound basal bulbs dark brown or black (in formalin). *Size:* Umbrella 3 mm. in height and 2½ mm. in width (largest specimens).

Early stage: Umbrella bell-shaped, about as high as broad, without a solid mass of jelly above the umbrella-cavity. Stomach small, on a broad but very short peduncle. Oral arms each with three to five clusters of nematocysts, arranged in a double row and always with a single terminal cluster. Medusa buds on the stomach, interradial, usually four. Gonads not developed. Tentacles, three or more in each perradial group and three in each interradial group. *Size:* Umbrella 1–2 mm. in height and width.

The collection contains twelve specimens taken in Stanley Harbour on 10 November 1898 and numerous specimens from the same locality, 6–11 November 1901; in addition, one specimen taken at Port Egremont 28 October 1909 during Vallentin's third voyage.

In the early stages the umbrella (about 1 mm. in diameter) is rather thin, and the large solid mass of jelly above the top of the subumbrella cavity is absent. This mass of jelly begins to develop during the intermediate stage and increases in size as the medusa grows. In the adult it is about one-third of the umbrella. The velum is much broader in the earlier stages than in the adult.

The stomach is somewhat cubical in shape, and its peduncle increases in length with the growth of the umbrella. In the early stages it is only just visible, but in the adult it is about the same length as the stomach.

The mouth tube below the stomach is fairly short, somewhat cross-shaped in a transverse section; its four perradial edges are somewhat thickened, containing a row of large, vacuolated cells, and these thickened strings are prolonged beyond the four perradial corners of the quadrangular mouth as four distinct oral arms (Plate XIX, fig. 1). The simple mouth rim has no free edge below the oral arms, but these are direct prolongations of the mouth rim into tentacle-like lips with clusters of nematocysts; they are not inserted some distance above the mouth rim as in *Lizzia* and *Bougainvillia*. These oral arms are unbranched in all stages, and have on their inner side clusters of nematocysts. The clusters vary in number in accordance with the age of the medusa. In the early stages there are only three clusters present: two lateral, opposite or nearly opposite each other, and one terminal cluster. The terminal cluster is always present in every stage, and the increase in number occurs only in the lateral clusters. Some of the large adults have oral arms with eleven clusters: a terminal cluster and ten lateral clusters arranged in two longitudinal rows. The oral arms are rather short, about the same length as the stomach, and do not extend so far down as the velum.

Medusa buds (Plate XIX, fig. 1) are present in the early and intermediate stages and sometimes also in the adult; they are placed interradially on the walls of the stomach. The little medusa ready for liberation has three tentacles in each of the eight groups, and its oral arms have a small terminal cluster of nematocysts and the first lateral pair is just appearing. As a rule asexual reproduction by gemmation ceases before the gonads are fully ripe, but occasionally medusa buds are still present at the same time as the gonads are nearly or fully mature.

In the male the gonads are divided by four narrow perradial furrows; they form roundish swellings occupying the whole of the interradial space and, except for the furrows, completely cover the stomach. In the female the ova also completely cover the stomach, but the perradial dividing furrows are not visible. Several specimens show that the ova remain attached to the stomach until the planula stage is reached. The largest planulae are at the upper end of the stomach and are held by a slender thread.

The different stages in the collection give a good idea of the development of the tentacles. The early stages have three tentacles in each of the eight groups. The interradial groups do not increase the number of their tentacles beyond three, except when a variation occurs, affecting one or two groups, but not all the groups. The tentacles in the perradial groups increase in number, and the maximum is five in each group.

The compound basal bulbs contain a dark brown or black pigment, but there is no definite ocellus.

The Falkland species is very much like *Rathkea octopunctata* (M. Sars), probably the only other existing species of the genus *Rathkea* as this is now defined (see Hartlaub, 1911, p. 228), and it has the same number of tentacles and the same arrangement of the tentacles. It also passes through an almost similar course of development. The shape of the oral arms marks the only difference between these two species: in *R. formosissima* the oral arms are simple and undivided and have a terminal cluster of nematocysts; in *R. octopunctata* their terminal end is bifurcated, carrying two clusters of nematocysts; in both species there are also a number of lateral clusters, one or two pairs on each of the oral arms in *R. octopunctata*, four or five pairs in fully developed specimens of *R. formosissima*.

Rathkea octopunctata belongs to the northern parts of the Atlantic and the Pacific and has also been recorded from the Mediterranean and the Black Sea. *R. formosissima* has up to now only been found at the Falkland Islands.

Table showing the characteristics of all the specimens taken in 1898

No. of tentacles in each group	Size of umbrella height–width mm.	No. of clusters of nematocysts on oral tentacles	Remarks
P. 3, 3, 3, 3 I. 3, 3, 3, 3	1 × 1	3	An early stage with medusa buds
P. 3, 4, 3, 5 I. 3, 3, 3, 3	1 × 1	3	An early stage. No medusa buds
P. 5, 5, 5, 5 I. 3, 3, 5, 4	2 × 2	5	Variation in the interradial series. Medusa-buds present
P. 5, 5, 5, 5 I. 3, 3, 3, 3	2 × 2	7	Medusa buds present
P. 5, 5, 5, 5 I. 3, 3, 3, 3	2 × 2	7	Four medusa buds, one ready for liberation
P. 5, 5, 5, 5 I. 3, 3, 3, 4	3 × 2½	7	Variation in the interradial series. Four medusa buds present
P. 5, 5, 5, 5 I. 3, 3, 3, 4	2½ × 2	7	Variation in the interradial series. The fourth tentacle just growing out. No medusa buds. Four masses of sperm
P. 3, 5, 3, 4 I. 3, 3, 3, 3	3 × 2	7	One medusa-bud. Gonads (male) appearing
P. 4, 3, 3, 5 I. 3, 3, 3, 3	3 × 2½	6–7	Ova or planulae present
P. 5, 5, 5, 5 I. 3, 3, 3, 3	2½ × 2	9	One medusa bud. Ova and planulae present
P. 5, 5, 5, 5 I. 3, 3, 3, 3	2½ × 2½	11	One medusa bud. Ova and planulae present
P. 5, 4, 5, 5 I. 3, 3, 3, 3	3 × 2	11	Ova and planulae present

Genus Bougainvillia Lesson (1836)

Syn. *Hippocrene* Mertens, 1835 (preoccupied).
Margelis Steenstrup, 1850.

GENERIC CHARACTERS. Margelidae with four perradial clusters of marginal tentacles, all of one kind and similar in structure. With four perradial oral tentacles, placed at some distance above the mouth rim, dichotomously branched, with terminal clusters of nematocysts.

Bougainvillia macloviana Lesson (Plate XIV, fig. 6; Plate XV, figs. 7–14).

Cyanaea bougainvillii Lesson, 1830, p. 118, pl. 14, fig. 3.
Bougainvillia macloviana Lesson, 1836, p. 262.
Bougainvillia macloviana Lesson, 1843, p. 290.
Hippocrene macloviana Haeckel, 1879, p. 90, Taf. V, figs. 1–2.
Hippocrene macloviana Pratt, 1898, p. 15.
Hippocrene macloviana Browne, 1902, p. 278.
Hippocrene Benham, 1909, p. 306, pl. 12, figs. 1–2.
Bougainvillia macloviana Mayer, 1910, p. 160.
Bougainvillia macloviana Hartlaub, 1911, p. 156, fig. 139.
Hippocrene macloviana Vanhöffen, 1911, p. 208.
Hippocrene macloviana Vanhöffen, 1912 *a*, p. 359, Taf. II, fig. 1.
?*Hippocrene macloviana* Vanhöffen, 1912 *b*, p. 11, Taf. I, fig. 7; Taf. II, fig. 10.
Bougainvillia macloviana Hartlaub, 1917, p. 406.
Bougainvillia macloviana Kramp, 1928, p. 50.
Bougainvillia macloviana Künne, 1933, p. 249, fig. 1.

SPECIFIC CHARACTERS. *Adult* (Plate XIV, fig. 6): Umbrella bell-shaped, as high as broad or a little higher than broad, with a quadrangular margin; longitudinal furrows on the exumbrella; gelatinous substance fairly thick, evenly rounded at the apex. Stomach small, cubical, situated on a broad, inverted cone-shaped, gelatinous peduncle; the stomach with four narrow perradial lobes extending along the whole length of the peduncle. Mouth small, with four short perradial lips, about two-thirds down the umbrella cavity. Oral tentacles four, perradial, closely and thickly branched, each with about 80–100 or more terminal branches with small clusters of nematocysts; basal, unbranched portion of oral tentacles very short. Gonads upon the stomach and the lobes of the stomach, hanging down in a folded band from the peduncle. Compound basal bulbs four, perradial, V-shaped; about 35–65 tentacles in each bulb, arranged in a double row. An ocellus at the base of every tentacle. *Colour:* Stomach, gonads, and compound basal bulbs pale yellow (in formalin or alcohol). Ocelli black. *Size:* Up to 15 mm. in height and 15 mm. in width.

The collection from 1898 to 1899 contains about 170 specimens of this species; the second collection, 1901–2, contains about 350, and in addition some beautifully preserved examples are at hand from November 1909 and January 1910. The specimens were all collected in Stanley Harbour, and all stages of development are represented, from the earliest up to the fully developed adult.

Extracts from R. Vallentin's notes: "11 November 1898. Very abundant under the stern of 'Great Britain' (a coal hulk moored in Stanley Harbour), very scarce elsewhere in the harbour." "12 November. Early stages with three tentacles on each bulb found near the stern of 'Great Britain'." "26 November. As abundant as ever." During the following time the species was repeatedly noted as "abundant". "4 January 1899. Steadily decreasing in numbers after the gale from the East." After that date it was never common. "6 February. A few seen, but they were all small." "5 November 1901. "A fair number observed in the sea." "12 November. Adult specimens scarce, a few youngsters present." "21 November. Increasing in numbers." Apart from a few days at the end of December the species was very abundant until the end of February. "10 January 1902. As numerous as on previous occasions and in all stages of development." "22 February. Shoals of *H. macloviana*, gonads ripe and ova discharged freely in my collecting jars." "5 March. Decreasing in numbers, several observed with gonads empty." "10 March. Only a few." "17 March. In shoals again." "22 March. Abundant." "26 March. Not very numerous."

The collections show that young specimens were present at any time during the whole period from the beginning of November 1901 to the end of March 1902; there are not many adult fully developed specimens in the collection; these were collected in November, but as will be seen from Vallentin's notes, mature specimens were also present from December to March. At Kerguelen Island this same species was found by Vanhöffen (1911, p. 208) on 29 December 1898. According to Vanhöffen (1909, p. 284) adult specimens of the medusa were also seen at Kerguelen Island in January 1902; the larvae of these medusae attached themselves on the bottom of the 'Gauss', where the hydroid was found with young medusae in the act of escaping on 19 March. At Campbell Island Th. Mortensen collected numerous large and middle-sized specimens on 10 December 1914 (Kramp, 1928, p. 50). Though the collections in these southern localities have all been made during the summer (November–March), it is evident that this medusa has a very long breeding season and may be found throughout the year. In the North Sea it occurs from April to June.

Since the voyage of the 'Coquille' there has been one species of the Anthomedusae known to exist at the Falkland Islands, and it was described by Lesson (1830). The descriptions of jelly-fishes given by early writers are usually somewhat vague, and this is no exception to the rule. The characters given are generic rather than specific, and the figures lack the necessary details. The figures by Lesson show very well the general appearance of the medusa, and they do not disagree with the general appearance of Mr Vallentin's specimens. The medusa was again taken by the 'Challenger' Expedition which visited the Falklands in 1876 (23 January to 6 February). These specimens were described and figured by Haeckel (1879). His description is based upon intermediate stages, and the drawing shows that the stomach and its peduncle were badly contracted, which is unfortunate, for his fine figure gives quite a wrong impression of this beautiful medusa. The umbrella, according to the description, is twice as high as broad, and cylindrical in shape. There are similar specimens in the present collections, but their condition shows that the umbrella is laterally compressed, no doubt owing to preservation. Miss Pratt (1898) records the occurrence of this same species in Stanley Harbour in 1896 (no description given, but name only).

The most adequate recent description of *Bougainvillia macloviana* is that given by Künne (1933). Though it is based on specimens from the North Sea, it agrees in all essentials with the description of those from the Falklands given by Browne in 1902 and, with a few additions, repeated above. A fine coloured drawing of a specimen from Kerguelen Island is given by Vanhöffen (1912*a*), and additional remarks on the morphology are published by Vanhöffen and by Kramp (1928). Vanhöffen (1912*b*) also records this species from Punta delle Vergine (in southern part of South America) and from Punta Arenas (Pacific coast of Costa Rica), but from the figures it seems doubtful whether the identification is correct. The occurrence in the south-eastern part of the North Sea (Hartlaub, 1917; and Künne, 1933) is undoubtedly due to casual transportation of the hydroid by ships. The hydroid was described from Kerguelen Island under the name of *Perigonimus maclovianus* by Vanhöffen (1909), who was also inclined to regard the small polyp described by Hartlaub (1911, p. 173) as *Bougainvillia superciliaris*, as belonging to the genus *Perigonimus*. Vanhöffen therefore proposed to remove the corresponding medusae from the genus *Bougainvillia* and only retain this generic name for the medusae derived from hydroids of the same name. For *macloviana* and *superciliaris* he reintroduced the generic name *Hippocrene*. As pointed out by Stechow (1919, p. 21) and Kramp (1928, p. 50) there is, however, no reason to refer the hydroids of these two species to *Perigonimus*; they are much more like the other *Bougainvillia* hydroids. Moreover, the name *Hippocrene* was preoccupied in 1817 by Oken for Mollusca.

THE DEVELOPMENT OF THE MEDUSA. The umbrella in the earliest stages is bell-shaped or globular, with very thin walls (Plate XV, fig. 8). As the medusa grows the walls increase considerably in thickness, and a mass of jelly is formed above the top of the umbrella cavity (Plate XV, fig. 7). In the intermediate and adult stages the umbrella is somewhat variable in its proportions, being either bell-shaped, of about equal height and width, or cylindrical, higher than wide. To a certain extent this variability in shape may be due to shrinkage in preservation. The exumbrella in the earliest stages is quite smooth and even, but during the early intermediate stages interradial longitudinal furrows begin to appear (Plate XV, fig. 9) and they become deep and conspicuous in the adult. There are also perradial furrows, which appear a little later; they are shallow, not nearly so deep as the interradial. In the jelly of the walls of the subumbrella there are eight adradial ridges which appear in the early intermediate stages and are well developed in the adult. Such ridges also occur in other genera and are regarded as muscular bands.

The margin of the umbrella is more or less quadrangular in all the stages, and the four compound basal bulbs form the four corners. When the margin is looked at from a lateral aspect, it is seen to curve slightly upwards between the basal bulbs, and the basal bulbs to hang down on a slight extension of the wall of the umbrella, forming in the largest adults a kind of lobe.

The velum is very broad in the early stages, but only of moderate width in the adult.

The stomach in the earliest stages has a quadrangular base and is either cubical or cone-shaped. The peduncle, which is so conspicuous in the later stages, is undeveloped. In some of the earliest stages an apical stalk is present on the top of the stomach, and it is the remains of the canal and stalk which connected the medusa to its hydroid. The apical stalk is confined to the earliest stages and is absorbed before the intermediate stages are reached. When the medusa has grown to about 2 mm. in diameter and has about five tentacles on each bulb, the stomach develops perradial lobes, and at the same time the peduncle begins to appear. The peduncle gradually increases in size, its base occupies the whole of the top of the umbrella cavity, and it hangs down, in the adult, like a broad inverted cone, about two-thirds as long as the umbrella cavity. The lobes of the stomach extend along the whole length of the peduncle, but never beyond it.

The mouth is comparatively small in all stages. When contracted it has four short perradial lips, but when expanded it is usually quadrangular, but sometimes circular.

The oral tentacles are always four in number, perradially situated, and their base or root is at the bottom of the stomach, a little above the mouth (Plate XV, fig. 14). In the earliest stage the oral tentacles are unbranched, and at the end of each one there is a small terminal cluster of nematocysts. As the medusa grows the simple oral tentacle bifurcates and becomes once dichotomously divided. The dichotomous branching continues (Plate XV, fig. 12), and each tentacle becomes like a little bush. After a time lateral branches appear and these become subdivided into numerous smaller branches. The growth is complicated to follow, but the diagram (Plate XV, fig. 13) shows how bush-like the oral tentacles become and how numerous are the terminal branches, each having a small cluster of nematocysts. In a fully developed adult the four oral tentacles have between them about 400 terminal branches, a deadly entanglement for small crustaceans.

The radial canals are fairly broad and conspicuous, running direct from the lobes of the stomach to the compound basal bulbs. The ring canal is smaller than the radial canals.

The gonads begin to appear round the stomach and upon its lobes when the medusa is about 2–4 mm. high. At first they form a mere swelling, but gradually increase in size. In the large adults they form a folded ribbon-like band which extends along the whole length of the peduncle and hangs down below the level of the mouth. Some specimens have free ova inside the umbrella cavity, and the ova are segmenting.

The compound basal bulbs show a considerable change in shape and appearance as the tentacles increase in number. In the earliest free-swimming stage, 0·5–0·75 mm. high (Plate XV, fig. 8), the medusa has two or three tentacles on each of the four basal bulbs, which are globular or spherical in shape. In the early intermediate stages, 2–4 mm. high, the bulb broadens and becomes heart-shaped and has now five to ten tentacles in a single row. As the tentacles increase in number (Plate XV, fig. 10) the sides of the bulb increase in length and curl slightly over, and the whole bulb becomes U-shaped and finally in the largest adults V-shaped. In some bulbs the sides of the V nearly meet, but this may be due to a general contraction of the umbrella.

When the medusa is about 4–6 mm. high and has about ten to fifteen tentacles on each basal bulb, an inner series of tentacles begins to appear, starting at about the fourth or fifth tentacle of the outer series, away from the apex of the U or V; in this way a double alternating row of tentacles is formed (Plate XV, fig. 11). This inner series is formed partly by a pushing inwards of the tentacles belonging to the outer row, partly by addition of new tentacles in both of the two rows. In most other species of this genus new tentacles are only developed at both sides of the basal bulb away from its apex, but in *Bougainvillia macloviana* young tentacles may also develop among the older ones, causing an overcrowding which results in a displacement of the tentacles, so that they become arranged in two rows, both of which contain old as well as young tentacles. In some of the largest bulbs, the rows become irregular in places and the tentacles three deep. The maximum number of tentacles counted on one bulb was sixty-six, but the more usual number for mature adults is about forty to fifty-five.

There is a large round or crescent-shaped black ocellus at the base of every tentacle. The ocellus is not on the tentacle itself, as in most other species of *Bougainvillia*, but on the basal bulb, and where two rows of tentacles exist the ocelli belonging to the outer row are squeezed forward and are situated on little projections. A few of the ocelli have particles of black pigment scattered around them and occasionally arranged in a circle.

The maximum number of tentacles in one basal bulb in some of the larger specimens was as follows:

Height of umbrella mm.	No. of tentacles	Height of umbrella mm.	No. of tentacles
6	16	12	47
9	32	13	61
10	35	15	55
11	40	15	65
12	45		

Family PANDEIDAE

Genus **Halitholus** Hartlaub (1914)

GENERIC CHARACTERS. Pandeidae with a large gelatinous apical projection; with numerous tentacles (eight or more). Manubrium with a broad, cross-shaped base; the longitudinal, perradial edges of the manubrium free, not connected with the radial canals by mesenteries. Gonads forming eight adradial rows of transversal folds, sometimes connected interradially by a horseshoe-shaped fold. Mouth rim slightly folded. Radial canals with almost smooth edges. Tentacle bulbs with or without an abaxial ocellus.

The genus *Halitholus* is distinguished from *Leuckartiara* and *Neoturris* by the complete absence of mesenteries connecting the upper parts of the perradial edges of the manubrium with the radial canals.

Halitholus intermedius (Browne) (Plate XIV, fig. 7; Plate XVI, figs. 1–2).

Tiara intermedia Browne, 1902, p. 277.

SPECIFIC CHARACTERS. *Adult:* Umbrella bell-shaped, little broader than high, with a large conical crown. Manubrium broad and massive, cross-shaped in transverse section; about half to two-thirds the length of the umbrella cavity. Mouth large, with four lips and the margin slightly folded. Gonads on the sides of the perradial lobes of the stomach and in small horizontal folds; sometimes an indication of an interradial horseshoe-fold near the base of the manubrium. Radial canals fairly narrow and with smooth edges. Tentacles usually eight (four perradial and four interradial), eight adradial bulbs without tentacles, and a variable number (up to sixteen) minute eradial bulbs. Ocellus on the abaxial side of every tentacular bulb and of the adradial bulbs. *Colour:* Manubrium, gonads, and basal bulbs pale yellow. Ocelli dark brown or reddish brown (specimens in formalin). *Size:* Umbrella 9–10 mm. in height (including the crown) and 7 mm. in width.

Early stage: Umbrella broader than high, with a small, pointed crown. Manubrium small, pyramidal, cross-shaped in transverse section; mouth with four small, but distinct lips, not folded. Gonads not visible. Two opposite tentacles, the two other perradial bulbs large, rounded, but without tentacles. Four very small interradial bulbs. The four perradial bulbs each with an ocellus. *Size:* 1 mm. in height (including crown) and 1¼ mm. in width (smallest specimen observed).

The collection from 1898 to 1899 contains five specimens belonging to early and intermediate stages (Plate XVI, fig. 1; Plate XIV, fig. 7); the full-grown adult stage not present. The second collection, 1901–2, contains numerous examples of all sizes. According to Vallentin's notes the first was seen on 4 December, and several were found on 16 December, but these are not preserved. Young specimens, 1–3 mm. high, were frequently found between 8 January and 21 March, and adult, sexually mature specimens between 22 February and 27 March.

The umbrella has thin walls, and the umbrella cavity is broader than high. The solid crown on the top of the umbrella is variable in shape; as a rule it is a tall conical process, like a spike on a helmet, but sometimes a broad truncated cone tending towards a globular mass of jelly. In one specimen the umbrella measures 3 mm. in height and 4 mm. in width, and its crown is 3 mm. in height and 3 mm. in width; in the largest specimen observed the umbrella is 5 mm. and the crown likewise 5 mm. high.

The stomach in a transverse section is cross-shaped, having four perradial lobes, the dorsal walls of which are attached to the subumbrella along the borders of a large perradial cross, but there are no lateral mesenteries. On each side of the perradial lobes the gonads form three horizontal folds. Specimens more than 5·5 mm. high are as a rule sexually mature.

The radial canals are fairly narrow and do not have a rugged edge, though they may be slightly undulated in much contracted specimens.

The tentacles are very long in some of the specimens, but the drawings show them more or less contracted. They are covered with minute nematocysts. The basal bulbs are large, and slightly laterally compressed, each having a large ocellus of a dark brown or reddish brown colour, situated on a small projection with a flat top, close to the exumbrella (Plate XVI, fig. 2).

The numerous specimens of all sizes show the development of the tentacles. The full number of marginal appendages in full-grown specimens is: eight tentacles (four perradial and four interradial), each with an ocellus; eight adradial bulbs with ocelli;

sixteen eradial minute bulbs without ocelli; but this complete number of appendages is only seen in a few of the largest specimens examined, $8\frac{1}{2}$–$9\frac{1}{2}$ mm. high. In the smallest specimens observed, about 1 mm. high, only two of the perradial tentacles are developed; they are placed opposite each other; the two other perradial bulbs are large and have ocelli, and very soon they develop into tentacles which, when the medusa is 3–4 mm. high, have attained the same size as the two first ones. The four interradial tentacles are indicated in the youngest stages as minute bulbs which soon grow larger and become provided with ocelli; they are developed into small tentacles when the medusa is 3–4 mm. high, but even in the adult the interradial tentacles are, as a rule, distinctly shorter than the perradial ones; only in some few of the largest specimens the eight tentacles are of equal length. The eight adradial bulbs begin to appear in specimens 3–4 mm. high; they soon become provided with ocelli, but they are never developed into tentacles, and even in the adult some of them may still be very small. The development of the small eradial bulbs proceeds in a rather irregular way; the smallest specimen, in which a few eradial bulbs are observed, is $4\frac{1}{2}$ mm. high, but on the other hand there are some of larger size, about 6 mm., which have no traces of eradial bulbs, and even in adult specimens the full number of sixteen is rarely present.

Irregularities in the development of the tentacles and marginal bulbs are sometimes observed. In some specimens one or more of the quadrants does not possess a single interradial tentacle, but has two tentacles, dividing this quadrant of the umbrella margin into three equal sections. In each of these sections a rudimentary bulb is developed, the middle (interradial) one always remaining very small, whereas the two lateral ones are larger and have ocelli. If this arrangement of the tentacles is carried through in all of the four quadrants the medusa will have twelve tentacles, eight rudimentary bulbs with ocelli, and four minute, interradial bulbs without ocelli. Two such individuals, in which a "duodecimal" arrangement of the tentacles is carried through in all four quadrants, are contained in the collection (both 7 mm. high); in other specimens the duodecimal arrangement is only found in one, two, or three quadrants. The largest specimen observed (10 mm. high) has ten tentacles, nine large bulbs with ocelli, and twelve minute bulbs without ocelli. Similar irregularities in the arrangement of the tentacles are observed in other species of Pandeidae (Kramp, 1926, pp. 77, 84, 93).

Two other species of *Halitholus* are known, both belonging to the arctic seas: *H. pauper* Hartlaub occurs on the north coast of Iceland, the west coast of Greenland, and at Kamtchatka; *H. cirratus* is known from Greenland, Spitzbergen, and the Barents Sea, and it also occurs as an arctic survivor in the cold basins of the Baltic. It is very interesting that a species of the same genus has been found at the Falkland Islands in the southern Atlantic. *H. cirratus* is considerably larger than *H. intermedius*; it has a greater number of tentacles, and there are no ocelli on the basal bulbs. *H. pauper* is only slightly larger than *H. intermedius*; it has only eight tentacles: four large perradial and four much smaller interradial; ocelli are present, but are much smaller and less conspicuous than in *H. intermedius*. Moreover, *H. pauper* is distinguished from *H. intermedius* by the shape of the gonads, which have a conspicuous horseshoe-fold.

In both of the northern species the large apical crown is rounded at the top, never pointed as in almost all specimens of *H. intermedius*.

Hartlaub (1905, p. 528, and 1914, p. 303) is inclined to think that "*Tiara intermedia*" Browne is identical with *Leuckartiara octona*, because the hydroid of this latter, *Perigonimus repens*, occurs at Tierra del Fuego and has also been found at the Falkland Islands. The investigation of the adult medusa shows, however, that it belongs to *Halitholus* and not to *Leuckartiara*. On the other hand the *Perigonimus* described by Hartlaub (1905) may not be *P. repens*, but another species of *Perigonimus*, possibly the hydroid of *Halitholus intermedius*.

LEPTOMEDUSAE

Family LAODICEIDAE

Genus **Laodicea** Lesson (1843)

Generic characters. Laodiceidae with a central stomach and mouth; with simply folded gonads on the four radial canals; with ocelli on the adaxial side of the basal bulbs of some or all of the tentacles.

The species belonging to this genus have been revised by Browne (1907), Mayer (1910), and Kramp (1919).

Laodicea pulchra Browne 1902 (Plate XVI, figs. 3–5).

Laodice pulchra Browne, 1902, p. 280.
Laodice pulchra Browne, 1907, p. 466.
Laodicea pulchra Mayer, 1910, p. 205.
Laodicea pulchra Kramp, 1919, p. 24.

Specific characters. *Adult:* Umbrella flatly curved, nearly twice as broad as high. Stomach very large, with four large perradial lobes extending nearly to the margin of the umbrella. Mouth with four large, slightly folded lips. Gonads extending from near the centre of the stomach to within a short distance of the ring canal, forming a series of short folds along the lobes of the stomach, where these are attached to the subumbrella. Tentacles about fifty, without a basal spur. Cirri absent. Sensory clubs (cordyli) generally three or four between every two tentacles, and each situated on a small bulb. Adaxial ocellus usually present at the base of every bulb with a tentacle or a cordylus. *Colour:* Stomach, gonads, and basal bulbs of tentacles of a pale yellowish colour (specimens in formalin). Ocelli black. *Size:* Umbrella 25 mm. in width and 15 mm. in height (largest specimen).

The collection contains five specimens, captured in Stanley Harbour on 10 and 11 November 1898; they belong to the intermediate and adult stages, the smallest specimen being 6 mm. in width and 5 mm. in height.

In the smallest specimen the umbrella is semiglobular and about as broad as high. The umbrella, as it grows, broadens and becomes flatter, so that in the large adult it is like a deep watch-glass in shape, being nearly twice as broad as high. In the smallest specimen the four lips of the mouth have a smooth edge, and the lobes of the stomach extend only about half way down the subumbrella; in the adult the lips have some few large folds, and the lobes of the stomach reach nearly to the ring canal, tapering off towards the distal end and terminating in a broad radial canal. In their proximal part the lobes are very broad, and they are in open connection with the central cavity of the stomach and not separated from it by longitudinal folds as in *Laodicea undulata* (see Kramp, 1919, pl. ii, fig. 2). The gonads form a series of short folds extending, in the adult, from near the centre of the stomach, along the lobes, almost to the ring canal (Plate XVI, fig. 4). They are situated on both sides of each lobe where it is attached to the subumbrella. In the smallest specimen the gonads are just beginning to develop, as a few folds near the distal end of the lobes of the stomach.

The basal bulbs of the tentacles are slightly longer than they are wide, somewhat flattened on the abaxial side, but convex on the adaxial side. There is no basal spur, as found in *L. undulata*. The tentacles are about as long as the radius of the umbrella, spirally coiled when contracted. Nematocysts in densely set transversal wrinkles, which are the most numerous on the adaxial side of the tentacle, fewer and more prominent on the abaxial side. Moreover, in a contracted state there are deep transversal folds on the adaxial side. It is important to note that cirri are not present in any of the specimens.

The sensory clubs or cordyli (Plate XVI, fig. 5) are large, $\frac{1}{2}$–$\frac{3}{4}$ mm. in length, club-shaped, without nematocysts. The number present between every two tentacles varies from one to five, but generally three or four are found. Each cordylus is situated on a bulb, which varies in size, and as a rule the central bulb between each pair of tentacles is the largest. At the base of each bulb, on the inner side, close to the velum, there is a black ocellus (Plate XVI, fig. 5), which makes its first appearance soon after the bulb begins to develop. The intermediate stages of the medusa clearly show that some of the bulbs, upon which the cordylus is situated, increase in size and become basal bulbs bearing a tentacle. The cordylus remains until the bulb has nearly reached its full growth, and disappears when the tentacle begins to develop from the bulb. The cordylus is always at the apex of the bulb, and a sufficient number of stages of growth are present to show that the cordylus is not pushed out of position by the growth of another bulb to carry the tentacle.

The following table shows the size, the number of tentacles, and the number of cordyli of the specimens taken:

Umbrella		No. of tentacles	No. of cordyli between tentacles
Width mm.	Height mm.		
6	5	17	1–3
10	—	16	3–4
11	—	16	3–5
15	11	30	3–4
25	15	47	3–4

L. pulchra differs rather considerably from the other species of the genus, in general appearance, in the shape of the stomach, and in the structure of the tentacles, particularly of their basal parts. It bears a considerable resemblance to the more primitive species of *Ptychogena*, *P. californica* Torrey (1909, p. 13) and *P. crocea* Kramp and Damas (1925, p. 290, pl. 35), but the presence of ocelli on the basal bulbs separates it from the genus *Ptychogena*.

Family MITROCOMIDAE

Genus **Cosmetirella** Browne (1910)

Generic characters. Mitrocomidae with four radial canals; with eight statocysts without ocelli; without marginal cirri.

Cosmetirella davisi (Browne) (Plate XVII, fig. 1).

Tiaropsis davisii Browne, 1902, p. 281.
Cosmetirella simplex Browne, 1910, p. 34, pl. i, figs. 6–8.
Phialella falklandica Vanhöffen, 1911, p. 223, Taf. 22, fig. 10.
Cosmetirella kerguelensis Vanhöffen, 1912*a*, p. 368.
Cosmetirella simplex Vanhöffen, 1912*a*, p. 368.
Cosmetirella davisi Kramp, 1932, p. 359, figs. 4, 34, 46.
Cosmetirella davisi Thiel, 1938, p. 327.

An account of the history of this medusa was given by Kramp (1932), who also gave a new description of the species and demonstrated the specific identity of *Tiaropsis davisi* Browne, *Cosmetirella simplex* Browne, and *C. kerguelensis* Vanhöffen. This result was obtained from an examination of the type specimens of *Tiaropsis davisi* and *Cosmetirella simplex*, during a stay at Berkhamsted, and also of some specimens in the British Museum, collected by the 'Discovery' in 1926 and 1927. A single specimen from South Georgia is described by Thiel (1938).

The following is a description of the largest specimen found at the Falkland Islands (Plate XVII, fig. 1):

Umbrella somewhat conical, a little broader than high, with moderately thick walls. Stomach small, cross-shaped when contracted. Mouth with four large fimbriated lips. Gonads occupying nearly the whole length of the four radial canals, not touching the stomach and not extending quite down to the margin of the umbrella, forming a thin, narrow, simple band. Tentacles seventy-seven (thirty-five larger and forty-two smaller ones), fairly short, with broad basal bulbs; nematocysts not in groups or rings. Statocysts eight, adradial, fairly large. *Size:* 11 mm. in width and 8 mm. in height.

The collection contains only three specimens, 9–11 mm. wide, taken in Stanley Harbour on 10 November and 6 December 1898. The species is not represented in Vallentin's second collection, 1901–2. The gonads in the largest specimen do not appear to be mature.

The species grows to a considerably larger size; the specimens collected by the 'Discovery' are 12–18 mm. wide, and those from Kerguelen Island, described by Vanhöffen, measured 19–36 mm. in diameter.

Cosmetirella davisi belongs to the antarctic and subantarctic seas; it is recorded from: Falkland Islands (Browne, 1902), South Georgia (Kramp, 1932; and Thiel, 1938), Kerguelen Island (Vanhöffen, 1912 *a*), Gauss Station at Kaiser Wilhelm II Land (Vanhöffen, 1912 *a*), and South Victoria Land (Browne, 1910).

This species is named after John Davis, an English navigator who discovered the Falkland Islands in 1592.

Family "EUCOPIDAE"

The family name "Eucopidae" is provisionally retained in the present paper, but a revision is needed, for the genus *Eucope*, from which the name is derived, has proved to be obsolete (see p. 296).

Genus **Obelia** Péron and Lesueur (1809)

Generic characters. "Eucopidae" with numerous solid tentacles; with eight adradial statocysts situated on the inner side of the basal bulbs of eight of the tentacles; no marginal cirri; a sack-like gonad on each of the four radial canals. Velum rudimentary.

Obelia multicia Browne (Plate XVI, figs. 6–8).

Obelia multicia Browne, 1902, p. 281.

Specific characters. *Adult:* Umbrella flat, disk-shaped. Stomach small, with a quadrangular base. Gonads globular or ellipsoid, about midway between the stomach and the margin of the umbrella. Tentacles short, about 100–120, with a large, heart-shaped basal bulb. Marginal statocysts small, adradial. *Size:* up to 3·5 mm. in diameter.

Vallentin's first collection contains sixteen specimens of this species, 1–3 mm. in diameter, taken in Stanley Harbour between 23 January and 4 February 1899. The second collection contains numerous specimens, from early stages, 0·35 mm. in diameter, to adults, 3·5 mm. wide, collected in Stanley Harbour 12 December 1901 to 17 January 1902. In the third collection there are some few specimens, taken at Port Egremont 28 October 1909 (one specimen) and at Roy Cove 23 November 1909 (eight specimens, 0·5–2·5 mm. wide).

As a rule it is impossible to distinguish the medusae of the various species of *Obelia* from each other. There is no doubt, however, that the specimens here dealt with all belong to one species, which is characterized by its large, heart-shaped tentacular bulbs. In the fully extended condition the basal bulbs may be globular as in other species of the genus, but in the vast majority of the specimens examined they are distinctly heart-shaped, being broader in their distal part than at the base (Plate XVI, fig. 7). Even in the youngest specimens the basal bulbs have this characteristic appearance.

The prolongation or root of the tentacle in the substance of the umbrella beyond the ring canal is short and has the appearance of a large cell, which is occasionally divided by a transverse septum.

In several specimens the mouth is fully expanded and is either oval or circular in shape, with a plain, simple marginal rim; but when the mouth contracts, four distinct lips of the usual type are formed.

The gonads show slight variations in shape, but are usually globular. In some of the larger specimens the ova are clearly visible and appear to be about ready for liberation (Plate XVI, fig. 8). In the smallest specimens the gonads are visible as minute points near the base of the stomach; during the growth of the umbrella they gradually shift their position from the proximal to the middle part of the radial canals, at the same time increasing in size.

The medusa in the early stages has only twenty-four tentacles, and these are all of the same size, which indicates that the medusa is liberated from the hydroid with twenty-four tentacles equally developed. When the medusa is about 0·8 mm. in width it has twenty-four large and twenty-four small tentacles, and the next series of forty-eight tentacles is formed almost simultaneously between the tentacles of the first and the second series. Even in the largest specimens with 100 or more tentacles the twenty-four primary tentacles may as a rule be recognized by the somewhat larger size of their basal bulbs, but they are not provided with a special pigmentation, as e.g. in *O. nigra* Browne. The largest number of tentacles counted is 120, in specimens 3·0–3·5 mm. wide.

Obelia sp. (Plate XVI, figs. 9–12).

Obelia diaphana Browne, 1902, p. 281.

DESCRIPTION. *Adult:* Umbrella disk-shaped. Stomach small, with a nearly quadrangular base. Mouth with four lips. Gonads spherical, attached to the radial canals by a short stalk and situated very close to the margin of the umbrella. Tentacles about 150, closely packed together. Marginal statocysts small. *Colour:* Stomach, gonads, and basal bulbs of tentacles of a pale yellowish colour (specimen in formalin). *Size:* 5 mm. in diameter.

The collection contains only a single specimen, upon which alone the description is based. It was taken in Stanley Harbour on 10 November 1898.

The condition of the ova shows that the medusa had reached the adult stage. The ova have the appearance of being enclosed in a little sac, which is attached to the radial canal by a short stalk or peduncle (Plate XVI, fig. 11). Three of the sacs have two opposite sides somewhat flattened in; the fourth is more truly spherical. It may be a slight contraction due to shrinkage in the preservation.

The eight marginal sense organs are not in a true adradial position; they are situated nearer the perradial canals and consequently are not equidistant. Probably a single statolith is contained in each vesicle, but not one is visible. Statoliths are seldom seen in specimens preserved in formalin.

The basal bulbs of the tentacles are small, either spherical or ellipsoid. The prolongation or root of the tentacle into the substance of the umbrella is cylindrical in shape and is divided by three or four transverse septa (Plate XVI, fig. 10). This root-like projection appears after the outgrowth of the tentacle; at first it is like a single cell; the septa, one by one, are formed later.

This medusa is quite distinct from *O. multicia*, described above; it closely agrees with the description and figures of *Eucope diaphana* A. Agassiz (1865, p. 83, figs. 115–25) and was first referred to that North American species which, however, is now generally supposed to be identical with *Obelia geniculata* (L.).

Genus **Phialella** Browne (1902)

Generic characters. "Eucopidae" with eight adradial marginal statocysts, each with two or more statoliths and situated on the margin of the umbrella between two tentacles. Many tentacles with hollow basal bulbs. No marginal cirri. A gonad on each of the four radial canals. Stomach not on a peduncle. Velum well developed.

This genus was established in 1902 with *Phialella falklandica* n.sp. as the genotype, also to comprise the British species *Ph. cymbaloidea* (=*quadrata*+*globosa* Forbes). There has been some doubt as to the correct name of this genus. Mayer (1910, p. 234) introduced the generic name *Eucope* Gegenbaur for a number of species with *E. globosa* (Forbes) as the genotype and including also *E. falklandica* (Browne). *Eucope*, in the sense of Gegenbaur (1856, p. 241), however, comprised a number of species all of which belonged to other previously known genera (*Phialidium*, *Clytia*, *Obelia*); it is, therefore, a synonym of these genera and must not be used for species belonging to other genera. Accordingly Keferstein and Ehlers (1861, p. 88) were wrong in referring their new species *Eucope picta* to *Eucope* Gegenbaur. Haeckel (1879, p. 168) established a new genus, *Eucopium*, comprising three species, *primordiale* n.sp., *pictum* Keferstein and Ehlers, and *quadratum* Forbes. Thus *Eucopium* is the first really new generic name used for Forbes's medusa and might be considered to have the priority over *Phialella* Browne. As, however, Rees (1939, p. 441) has recently selected *Eucopium primordiale* Haeckel as the genotype of *Eucopium*, and this is a doubtful species which is not cogeneric with *quadratum* Forbes, *Eucopium* must be cancelled, and the next generic name, *Phialella* Browne, adopted as the generic name of *Ph. quadrata* Forbes and the closely related *Ph. falklandica* Browne, with the latter as the genotype.

Phialella falklandica Browne (Plate XVII, figs. 2–4; Plate XIX, figs. 3–5; Fig. 1).

Phialella falklandica Browne, 1902, p. 282.
Eucope falklandica Mayer, 1910, p. 237.
Phialella sp. Benham, 1909, p. 307, pl. 12, figs. 3–6.
Phialella falklandica Vanhöffen, 1912*b*, p. 21.
non Phialella falklandica Vanhöffen, 1911, p. 223.

Specific characters. *Adult* (Plate XVII, fig. 2): Umbrella semi-globular, little broader than high, with thick walls. Stomach short and quadrangular. Mouth with four lips and a fimbriated margin. Gonads hanging down in wavy folds, occupying nearly the whole length of the four radial canals, not touching the stomach and not extending quite down to the margin of the umbrella. Tentacles sixty to seventy, with large basal bulbs. Statocysts eight, adradial, with two or more statoliths. *Colour:* Stomach, gonads, and basal bulbs pale yellow (in formalin). *Size:* 17 mm. in width and 11 mm. in height (largest specimen).

The first collection contains eight specimens, taken in Stanley Harbour on 10 November and 6 December 1898, which comprise a series extending from an intermediate to the adult stage. In the second collection there are numerous specimens (about 120), showing a complete series from a very early stage, 0·8 mm. in diameter, to intermediate stages, about 6 mm. wide; they were taken in Stanley Harbour from 22 February to 27 March 1902. There are also some few specimens, 1–8 mm. wide, in the third collection, taken on 19 January and 3 February 1910, probably also in Stanley Harbour.

The umbrella in the early stages is a little higher than wide, with thick walls; it gradually becomes broader in proportion to its height as it grows.

The stomach is decidedly quadrangular in shape, having also a quadrangular base, without perradial lobes; in the young stages it is somewhat longer than broad, but in the intermediate and adult stages it is not quite as long as broad. The mouth, when closed, has four conspicuous perradial lips; in the early stages it has a plain margin, but when the medusa is about 3 mm. wide a folding of the mouth rim begins to appear, and in the intermediate and adult stages the margin is distinctly folded. The folds are numerous and closer together near the apex of the lips. There are also four large interradial folds which, when the mouth is closed, form small secondary lips placed at right angles to the primary perradial lips.

The gonads in the early stages are visible as minute dots in the middle of the radial canals. As the medusa grows, they become elongated and at the same time are gradually displaced towards the distal parts of the radial canals; when the umbrella is about 5 mm. wide the gonads are oval swellings on the fourth 1/5 or the fifth 1/6 of the radial canals. In the intermediate stages, 6–10 mm. in width, the gonads form a thin narrow ridge, broken into slight wave-like folds (Plate XVII, fig. 3). In the adult they hang down from the radial canals, and the wave-like folds are more curved and conspicuous. They also occupy a great length of the radial canals, leaving only a very small space vacant at each end of the canal. The gonads are parted in the median line on the subumbrella side.

The basal bulbs of the tentacles are large and globular or pear-shaped, with a heart-shaped base, and evenly covered with nematocysts (Plate XIX, fig. 3). The tentacles, when moderately extended, are somewhat longer than the diameter of the umbrella and very thin; they are closely packed with transverse circular bands of nematocysts (Plate XIX, fig. 4), except in their proximal part where the bands are more or less confluent. The basal bulbs are hollow (Plate XIX, fig. 5) and in the proximal part of the tentacle the endoderm cells are placed in several rows, but there is no central hollow space, except very close to the basal bulb; in the greater part of the length of the tentacle, from the point where the nematocyst bands are completely separated from each other, the endoderm consists of one single row of cylindrical cells.

The earliest stages observed have no remnants of the apical canal which has connected the young medusa with its hydroid, and may already be somewhat advanced in development from the moment of liberation. The European species, *Phialella quadrata*, begins its free-swimming life with four perradial tentacles and four marginal statocysts, each containing two statoliths. In the next stage there are eight tentacles and eight statocysts. The youngest specimens of *Ph. falklandica* all have eight adradial statocysts and four perradial tentacles, and the four interradial tentacles are just beginning to develop and are visible as four minute bulbs. When the medusa is 1 mm. in diameter there are, as a rule, eight tentacles, four large perradial and four smaller interradial. The next series of eight tentacles are developed between the perradial tentacles and the adradial statocysts, close beside the latter; they are followed by another series of eight tentacles which appear on either side of the interradial ones, and after them come eight tentacles flanking the perradial. From this time the addition of new tentacles becomes less regular (diagram, Fig. 1).

The rate of development of the tentacles in proportion to the size of the umbrella shows some variation, but the numbers most frequently found are as follows:

Diameter of umbrella mm.	No. of tentacles + bulbs
0·8–1·0	4+4
1–1½	8+0
1½–2	8+8
2–3	16+0, sometimes 8+8
3–5	16+8, sometimes 24+0
5–8	24+0, up to 32+8
10	About 40 tentacles
12	About 48 tentacles
17	About 64 tentacles

The marginal vesicles or statocysts are large and globular in shape (Plate XVII, fig. 4). As some of the specimens are preserved in alcohol the number of statoliths may be stated; in the intermediate stages each statocyst contains three to four statoliths, but in the early stages there are only two. The vesicle is situated on a broad, cushion-like bulb.

The velum is well developed, and in the young stages it is remarkably broad.

As mentioned above, the medusa recorded by Vanhöffen (1911) as *Ph. falklandica* from Kerguelen Island and the surrounding area really belongs to *Cosmetirella davisi*. It seems probable, on the other hand, that the specimens described by Vanhöffen in his paper on the medusae collected by the 'Vettor Pisani' (Vanhöffen, 1912*b*) under the name of *Phialella falklandica* were correctly identified; they were found in various localities on the coasts of South America: Punta Arenas and Fortescu in the Strait of Magellan, Valparaiso in Chile, and Callao in Peru. The excellent description and figures of a *Phialella* from the Auckland and Campbell Islands south of New Zealand by Benham (1909) leave no doubt of its identity with *Ph. falklandica*. Owing to the small height in proportion to the diameter of the umbrella Benham hesitated to refer his specimens to the Falkland species, but in all other respects, and in the development of the tentacles, they agree so perfectly with this latter that the identity seems beyond doubt. Two species, described by von Lendenfeld (1884), *Eucope annulata* (p. 602, pl. 28, figs. 53–57) from Lyttleton Harbour, New Zealand, and *E. hyalina* (p. 920, pl. 42, figs. 16–17) from Sydney Harbour, New South Wales, Australia, may belong to the genus *Phialella*, but the descriptions and figures are so deficient that it will be impossible to identify the species. The European species, *Ph. quadrata*, differs from *Ph. falklandica* mainly in its gonads which are much shorter and with plain sides, not hanging down in folds.

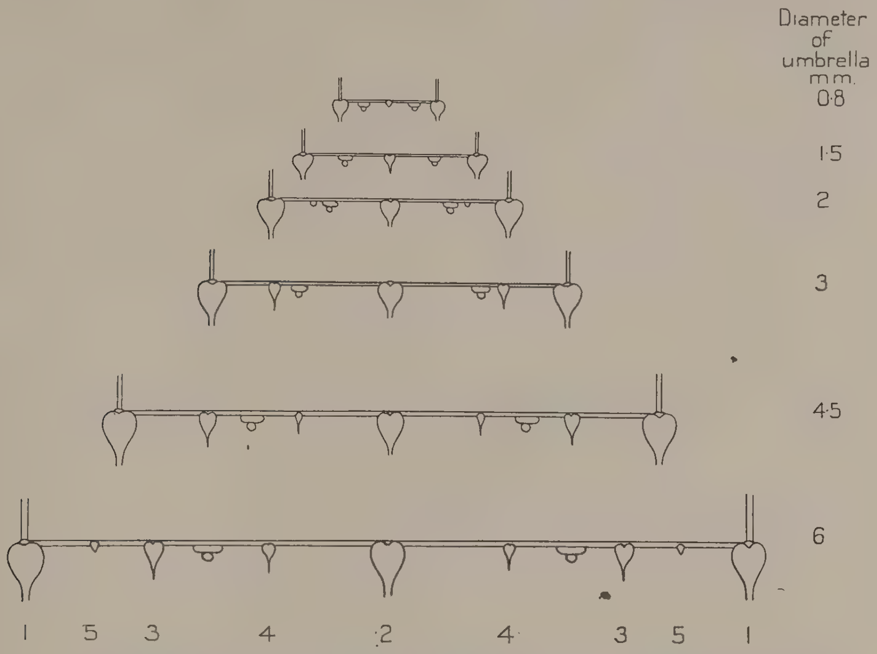

Fig. 1. *Phialella falklandica.* Diagram showing the rate of development of the tentacles.

Genus **Phialidium** Leuckart (1856)

Generic characters. "Eucopidae" with sixteen or more tentacles and with one to three marginal sensory vesicles between every two tentacles; no marginal cirri. A gonad on each of the four radial canals. Stomach not on a peduncle.

Phialidium simplex Browne (Plate XVII, figs. 5–9)

Phialidium simplex Browne, 1902, p. 282.
Phialidium simplex Browne, 1908, p. 236.
Phialidium simplex Mayer, 1910, p. 274.
Phialidium simplex Thiel, 1938, p. 328.

SPECIFIC CHARACTERS. *Adult*: Umbrella watch-glass-shaped, twice to three times broader than high. Stomach short, with four short perradial lobes. Mouth with four large fimbriated lips. Gonads extending over the outer half of the radial canals and reaching nearly down to the ring canal; slightly folded. Tentacles sixty to eighty-five, and a few young tentacular bulbs, the maximum number probably about 100. Marginal vesicles small, one between every two tentacles, with a single statolith. *Colour:* Stomach, gonads, and basal bulbs of tentacles pale yellow (in formalin). *Size:* Umbrella 22 mm. in width and 10 mm. in height (largest specimen).

The first collection contains about sixty specimens, obtained from November 1898 to February 1899; in the second collection there are about 800, collected in Stanley Harbour from 6 November 1901 to 27 March 1902, forming a good series from a very early stage up to the adult. There is also one young one in the third collection, taken on 28 October 1909 at Port Egremont. The smallest specimen in the first collection is about 2 mm. in width and height, in the second collection there are several in still younger stages, down to 0·6 mm. in diameter. In these tiny medusae the apical canal, which connected the medusa with the hydroid before liberation, is still visible, so that they apparently represent an early stage of the free medusa, shortly after liberation.

DEVELOPMENT OF THE MEDUSA. The umbrella in the youngest stages is about as high as broad, or a little higher than broad, but as it increases in size it gradually becomes broader, thinner, and flatter. The stomach in the early stages is quadrangular, but becomes cross-shaped when empty and contracted. In the intermediate stages the stomach shows the commencement of four short perradial lobes, which become larger and more conspicuous in the adult. The mouth in the early stages has four little lips, with a plain margin; in the intermediate stages folds appear on the margin (Plate XVII, fig. 5); in the adult the lips are large and have a well-marked fimbriated margin (Plate XVII, fig. 8).

The gonads are visible in the very earliest stages as minute globular swellings near the top of the lower half of the radial canals; they soon become oval and gradually increase in length. The growth of the gonads is illustrated in a series of drawings (Plate XVII, fig. 9); they are all drawn to the same scale and the measurements are taken from the ring canal. The gonads grow outwards or downwards with the growth of the umbrella and occupy the outer half of the radial canals. They also become folded; the folds first appear in the intermediate stages.

The tentacles have globular or pear-shaped basal bulbs (Plate XVII, fig. 7) and are rather thin and short, spirally coiled when contracted. In some of the large adult specimens there is a decided tendency towards twinning, either two tentacles on one bulb, or two bulbs, with tentacles, joined together.

The marginal vesicles, or statocysts, are small, closed vesicles, and contain a single statolith (Plate XVII, fig. 7). The normal number is one between every two tentacles, and by this the Falkland specimens are distinguished from most other species of *Phialidium*. Occasionally two statocysts may be found between two tentacles, but only in one or two places on the margin of one and the same specimen.

It is difficult to draw definite boundaries to mark off the different stages, except in the early stages where the number of tentacles may be taken as a guide and three divisions formed:

First stage, diameter of umbrella 0·6–0·9 mm. Four perradial tentacles and four interradial basal bulbs; eight adradial marginal vesicles.

Second stage, diameter about 0·7–1·2 mm. Eight tentacles (four perradial and four interradial), eight small basal bulbs developing close beside the eight adradial marginal vesicles.

Third stage, diameter about 2·0–2·5 mm. Sixteen tentacles (four perradial, four interradial, and eight adradial), sixteen small eradial bulbs just appearing, sixteen marginal vesicles.

After the third stage come the intermediate stages, and it is practically impossible to classify them into divisions. The number of tentacles is very variable and is not correlated with the size of the umbrella, nor the size of the gonads. When the umbrella is about 5 mm. in width, the gonads are about 2 mm. long, situated near the margin of the umbrella; about twenty to thirty tentacles and nine to twelve tentacular bulbs; one marginal vesicle between every two tentacles or bulbs. The intermediate stages may be characterized by having immature gonads and more than sixteen tentacles. It is only by the state of the gonads that it is possible to tell when the adult stage is reached; and the gonads, even when ripe, do not indicate that the medusa has reached its maximum growth.

Abnormal specimens. In the first collection one specimen was observed with three radial canals and three gonads; stomach triangular, mouth with three lips. Thirty-two tentacles, and twelve tentacular bulbs. Umbrella 13 mm. in diameter. In the second collection there is one specimen, 4 mm. wide, with six radial canals and six gonads; the space between two of the radial canals is somewhat narrower than the other five spaces. There are twenty-one tentacles, eighteen tentacular bulbs, and twenty-two marginal vesicles.

Young and intermediate stages as well as adult specimens were found together at any time during the period from the beginning of November 1901 to the end of March 1902.

Ph. simplex, which is a very common medusa at the Falkland Islands, has recently been recorded from the Patagonia Bank, east of Rio Grande do Sul on the east coast of South America, about 30° S, where one small specimen, 2 mm. in width, was found by the 'Meteor' Expedition (Thiel, 1938).

Among the numerous species of *Phialidium* described, only one species may be said to bear a close resemblance to the Falkland species, viz. *Ph. islandicum* Kramp (1919, p. 95). This species occurs in the northern Atlantic, round Iceland and between the Shetland Islands and Norway; it may grow to a considerable size, more than 40 mm. in diameter, with about 200 tentacles; moreover, it is distinguished from *Ph. simplex* by the greater length of the gonads. Intermediate stages of *Ph. islandicum*, however, are much like *Ph. simplex*, and both species are characterized by the number of marginal vesicles being equal to the number of tentacles.

LIMNOMEDUSAE

Family WILLIIDAE

Genus Willia Forbes (1846)

Generic characters. Williidae with six or more radial canals, each having one or more lateral branches (youngest stage without branches), all running to the margin of the umbrella. Stomach with six or more lobes. Gonads surrounding the stomach and extending along the lobes of the stomach.

The other genus of this family, *Proboscidactyla* Brandt, is distinguished from *Willia* by the possession of only four stomachal lobes and four main radial canals. A revision of the species of Williidae was carried out by Browne (1904, p. 724); as pointed out by Thiel (1938, p. 302) a new revision is, however, desired. The species described below even tends to efface the limits of the two genera.

Willia mutabilis Browne 1902 (Plate XIV, figs. 8–9; Plate XVII, figs. 10–12; Plate XIX, fig. 12; Figs. 2–12).

Willia mutabilis Browne, 1902, p. 280.
Willia mutabilis Browne, 1904, p. 729.
Willia mutabilis Browne, 1908, p. 235.
Willsia mutabilis Mayer, 1910, p. 194.
? *Willia mutabilis* Vanhöffen, 1912, p. 7, text-fig. 2.
Willsia mutabilis Thiel, 1938, p. 302.

Specific characters. *Adult:* Umbrella slightly conical in shape, with a broad round summit, about as broad as high; margin slightly inverted. Stomach small, with six or eight lobes. Mouth with a closely folded margin. Six or eight main radial canals, each with three or more branches, all running to the margin of the umbrella. Gonads surrounding the stomach and the lobes of the stomach. Twenty-four tentacles or more (maximum number counted fifty-four). *Colour:* Stomach and gonads yellowish brown; basal bulbs of tentacles dark brown or black (specimens in formalin). *Size:* Umbrella 6 mm. in height and 6 mm. in width (largest specimen).

Numerous specimens were collected in Stanley Harbour from November 1898 to February 1899 and from 13 November 1901 to 22 March 1902. They show various stages in development, and a great variation in the radial canal system and in the number of lobes to the stomach. As a matter of fact, they show so much variability that the normal characteristics of the species remain doubtful. It has normally eight branched radial canals, but frequently six, and the number varies from five to eleven.

The umbrella in the early stages is bell-shaped; it broadens as it grows and becomes somewhat cone-shaped. The walls of the umbrella are thick, and the upper third or half is solid. The velum is narrow. In the exumbrella, near the margin and between the tentacles, there are clusters of nematocysts (Plate XVII, fig. 10), and as the umbrella grows downward the clusters remain on the exumbrella. Similar clusters are found in the exumbrella of *Willia stellata* and of the species of *Proboscidactyla*. Their structure in *Willia stellata* has recently been described by Ranson (1937, pp. 321–4, fig. 1) who found that they are not situated externally upon the exumbrella, but immediately below the ectodermal epithelium of the exumbrella and connected with the umbrella margin by a narrow string of endoderm cells. These structures are called by Ranson "cnidothylacies".

The stomach is short, about one quarter the length of the umbrella cavity, and has a number of lateral lobes; the number of lobes is variable, but apparently the normal number in adult specimens is eight. The mouth is very variable in shape, and in many specimens the shape is probably due to contraction and contortion. In the early stages it is circular when fully expanded, but it has large lips, usually four, when closed. Later on, definite lobes or folds begin to appear (Plate XVII, fig. 11), and in the large adults the lobes or folds are numerous and closely packed together. Sections show that the lobe or fold is tricornuate. The true form of the mouth in the adult cannot be ascertained, beyond that the margin is closely folded; none of the specimens have the mouth properly expanded, in all it is more or less contracted.

The gonads surround the stomach and also the lobes of the stomach. Several series of sections were cut for the purpose of seeing the exact position of the gonads (Plate XVII, fig. 12).

The length of the tentacles, when fully extended, is about 1½–2 times the diameter of the umbrella. The basal bulb contains a central mass of dark brown or black pigment when fully developed (Plate XIV, fig. 9), but at an early stage the bulb is yellowish brown. The basal bulb is inside the wall of the umbrella, and the proximal part of older tentacles is partly embedded in the jelly of the umbrella margin, the point of issue of the free tentacle being somewhat displaced towards the exumbrella. In some other species of Williidae the tentacles are known to issue from the umbrella in a similar way, and in this respect, as well as in the structure of the gonads, the Williidae resemble certain species of Moerisiidae and Olindiidae. The structure of the tentacle itself is likewise in accordance with that observed in these families of Limnomedusae; the tentacle is hollow, though in the greater part of its length the central lumen is very narrow. In the proximal part of the tentacle the nematocysts form minute, scattered groups; at a short distance from the base the groups of nematocysts are larger and broader and are arranged in two longitudinal rows (Plate XVII, fig. 12); still farther out these two rows become united, forming a series of crescent-shaped clusters on the abaxial side of the tentacle, and towards the distal end of the tentacle the clusters gradually become annular, surrounding the tentacle as complete, distinctly separated rings. In *Willia stellata* and in several species of *Proboscidactyla* the tentacles are likewise known to have annular clusters of nematocysts.

Sections show that a ring canal of the usual form is absent. The radial canals have a distinct lumen and open into a large cavity inside the basal bulb of each tentacle, but no open canal is seen round the margin of the umbrella. There is a band of endoderm cells round the margin, in the position of the ring canal, but no trace of a cavity inside the cells, exactly as in other species of *Willia* and *Proboscidactyla*. The band of cells round the margin gives the external appearance of a ring canal.

The Falkland species apparently passes through a series of stages in development somewhat similar to those gone through by the British species *Willia stellata.* A brief description of the stages of *W. stellata* may help towards the elucidation of the stages of the Falkland species which is subject to so much variation. The development of the medusa, *W. stellata*, may conveniently be separated into four stages which are based upon the radial canal system:

First stage: Stomach with six lobes, from each of which runs a radial canal without any branches (called the main radial canal in the later stages) to the margin of the umbrella. Six tentacles, one opposite each canal.

Second stage: Six main radial canals, each with one lateral branch. Twelve tentacles, one opposite each canal.

Third stage: Six main canals, each with two branches, opposite each other, all running to the margin. Eighteen tentacles.

Fourth stage: Six main canals, each with three branches; the third branch comes from a lateral canal and not from the main canal itself. Twenty-four tentacles. (Adult stage.)

It will be seen that as the medusa grows the radial canals become branched; the branches increase in number, and a corresponding increase takes place in the number of tentacles.

The mode of formation of the branches in *W. mutabilis* is somewhat uncertain. Blindly ending canals are very rarely seen, but when a young tentacle bulb is just beginning to make its appearance on the umbrella margin, it is usually seen to be connected with the previously existing canals by a delicate, almost imperceptible streak of cells. Apparently, therefore, each new branch is the result of a differentiation of cells in the endoderm lamella of the umbrella taking place in the whole course of the future canal branch simultaneously, and not progressing from one end to the other.

Each new tentacle makes its appearance below one of the exumbrellar clusters of nematocysts and for some time, during the growth of the tentacle, the nematocyst cluster is seen above the young tentacle, but later on it is gradually displaced to one side.

As pointed out by Browne (1896, p. 471, and 1897, p. 823), abnormal specimens of *W. stellata* may occur, having a number of main radial canals other than six. In the Falkland specimens such irregularities are much more frequently found. For the description of the development and the variations in *W. mutabilis* it will be convenient to divide the specimens into three groups: (1) Specimens with eight main radial canals regularly arranged. (2) Specimens with six main radial canals regularly arranged. (3) Irregular specimens. Within each of these groups the specimens are subject to some individual variation; specimens in the same stage of development of the canal system are of varying size, and the branching of the canals does not always proceed at the same rate in all of the main canals in one and the same specimen. Apart from such individual variations the development is as follows:

(1) Specimens with eight main radial canals, regularly arranged (forty-one specimens examined). In the youngest specimens observed, about 1 mm. in width, the stomach is

quadrangular, with only an indication of four perradial lobes. In the collection from 1901 (20 November) there are three very interesting young specimens showing the first development of the canals. In two of them there are eight simple radial canals without any branches (Fig. 2); two canals run from each of the four corners of the stomach to the margin of the umbrella, but these two canals are unequal. One of them proceeds in a perradial direction to the umbrella margin, and at its termination there is a large tentacle; the other canal from the same corner of the stomach runs in an oblique direction to a point of the margin in the middle of the space between two perradial tentacles; at its termination there is a small rudimentary tentacle bulb, and above this there is an exumbrellar nematocyst cluster, whereas such are not found above the four perradial tentacles. In later stages the eight "main" radial canals are all alike in appearance, but from these young stages it is evident that only four of them are truly primary radial canals, whereas the four others are lateral branches of the former. Presumably therefore a still younger stage exists, with only four radial canals, as in young specimens of *Proboscidactyla*.

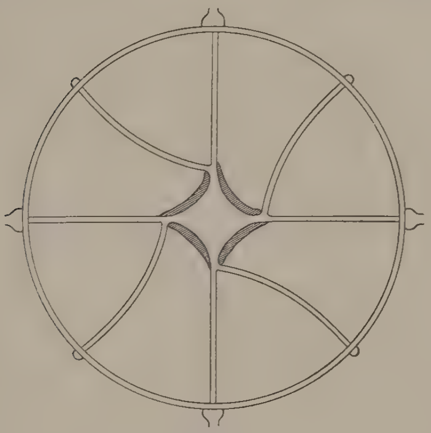

Fig. 2. *Willia mutabilis*. The radial canal system of the earliest stage, showing four primary, perradial canals and four canals running to the four interradial tentacular bulbs.

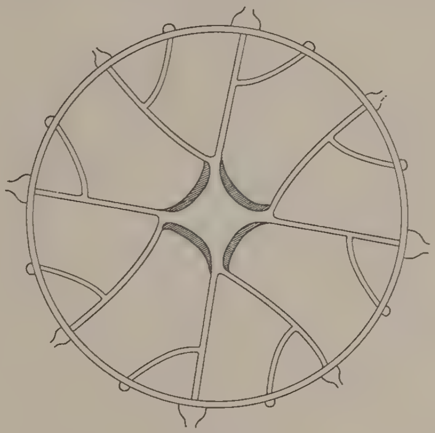

Fig. 3. *Willia mutabilis*. The radial canal system of an early stage, showing commencement of torsion of the umbrella; also a single branch to each of the eight radial canals.

In the third specimen of this sample a torsion of the umbrella has just commenced (Fig. 3); the course of the four primary canals is not exactly perradial in relation to the stomach, and the corresponding tentacles are a little displaced, in a clockwise direction when the medusa is seen from above. The four interradial basal bulbs have developed into tentacles which, however, are distinctly smaller than the four perradial ones; moreover, there is a lateral branch to each of the eight radial canals, issuing somewhat nearer to the umbrella-margin than to the stomach, all to the same side; at the termination of each of these lateral branches is a very small basal bulb, and above each of these a cluster of nematocysts.

There are several slightly older specimens in which the two radial canals issuing from each corner of the stomach are equally divergent from the perradial direction, each of them having one lateral branch (Fig. 4). These specimens are 1–2½ mm. in diameter and have sixteen tentacles. The basal bulbs of the tentacles opposite the eight main canals are much larger and more fully developed, having more pigment and deeper in colour, than those opposite the branches. The tentacles are also longer and thicker.

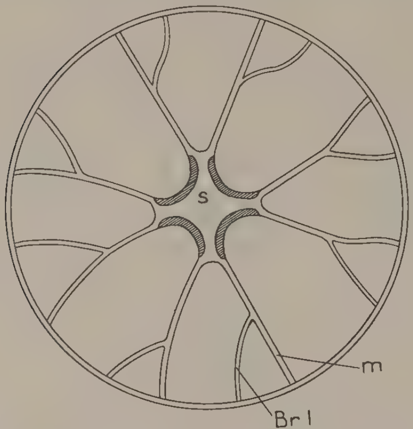

Fig. 4. *Willia mutabilis.* A slightly older stage, in which the two radial canals leaving each of the four corners of the stomach are equally divergent from the perradial direction, each of them having one lateral branch.

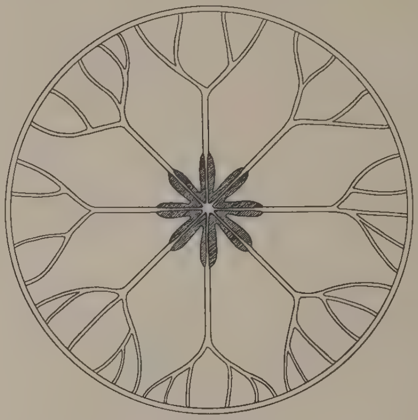

Fig. 5. *Willia mutabilis.* The radial canal system of an adult having a stomach with eight lobes.

The second branch in the radial canal system is very variable in position; it may either come off from the main canal (Fig. 6 A, B, E) or from the first branch (Fig. 6 C, D). Specimens with two branches to each of the eight main radial canals are 2–4 mm. in diameter and have about twenty-four tentacles, some of which may, however, be in a juvenile stage of development.

The third branch is likewise variable and may either come off from the main canal (Fig. 6 F, H) or from the first branch (Fig. 6 G, I). There are several specimens in which some of the main canals have two branches while others have three; the number of tentacles varies in accordance herewith. Specimens with three branches to all of the eight main canals are 3–4½ mm. in diameter and have about thirty-two tentacles.

In the largest specimens observed within this group (4–5 mm. wide) the number of branches to the main canals varies from three to five (Fig. 5), but the maximum number of five is never seen in all of the main canals of one individual. The greatest number of canals (main canals + branches) reaching the umbrella-margin in specimens with eight main canals, as observed in the present material, is forty-one, and the greatest number of tentacles is likewise forty-one.

In the young specimens the stomach has only four undivided perradial lobes, two radial canals coming off from the end of each lobe (Figs. 2–4). Later on the lobes become broader (Fig. 7 *a*), and each of them begins to bifurcate (Fig. 7 *b*), forming two secondary lobes growing out along the proximal part of each of the two canals, until in the adult stage the stomach has eight radial lobes of equal size and appearance and separated by equal incisions (Fig. 5). The development of the stomachal lobes is illustrated in Fig. 7*a*–*b*. The central cavity of the stomach is not subject to a corresponding secondary division, but is always cross-shaped in transverse section; even in the adult, where the eight peripheral lobes are fully and equally developed, the central cavity has only four longitudinal ridges. The rate of development of the stomachal lobes does not strictly follow that of the radial canals; eight distinct lobes may be present in specimens with only two to three branches to each main radial canal, but in others with three to four branches to the main canals the division of the four primary lobes of the stomach is far from being completed.

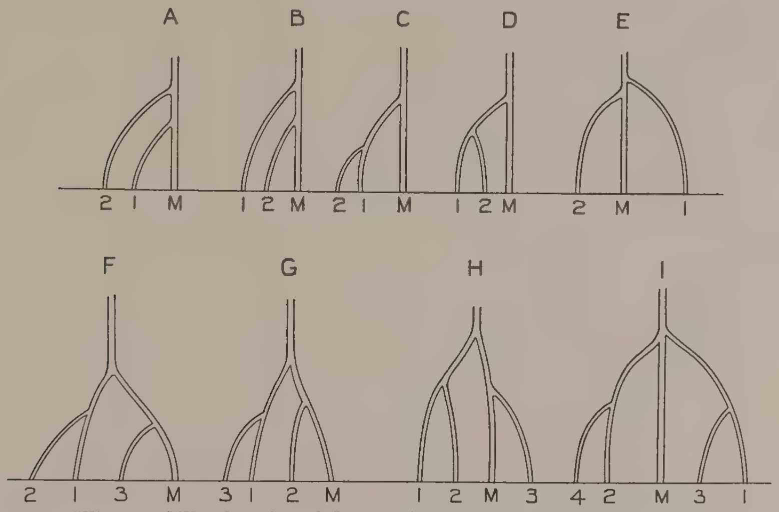

Fig. 6. *Willia mutabilis.* A series of figures showing the development of the branches of the radial canals, and the variations in the order of arrangement.

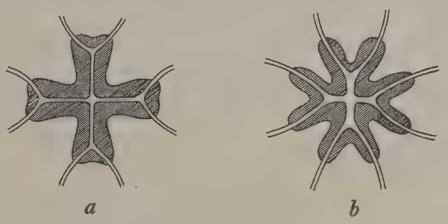

Fig. 7. *Willia mutabilis.* The stomachs of two intermediate stages: *a*, with four undivided lobes; *b*, with four bifurcated lobes.

(2) Specimens with six main radial canals, regularly arranged (twenty-two specimens examined). The mode of branching of the radial canals is entirely the same in the six-rayed specimens as in those with eight main radial canals, but the final number of branches to each main canal is larger, six or more. Apparently the six main radial canals as well as the six stomachal lobes are all of equal origin (as in *Willia stellata*), but this cannot be decided with certainty, as no very young specimens of this group are present. The youngest (16 January 1902) has already two branches to each of the main canals; it is 1½ mm. in diameter and has twelve tentacles and six small basal bulbs. Ten specimens, 1½–3 mm. wide, have three branches to each main canal; some of them have twelve tentacles and twelve small bulbs, others have twenty-four tentacles.

The subsequent branching does not proceed at absolutely the same rate in all of the main canals, but there are some specimens, 4–5 mm. wide, with four branches to each main canal and with thirty tentacles, and one in which every main canal has six branches; this specimen is 5 mm. wide and has forty-two tentacles. The largest specimen of this group (Fig. 8) is 6 mm. in diameter and has fifty-four tentacles, the largest number observed in the whole collection; the number of branches to each main radial canal varies from six to ten (8, 8, 8, 6, 8, 10).

(3) Irregular specimens (twenty-two examined). Some of the variations observed are seen in Figs. 9–12. The variability of all the irregular specimens is given in the accompanying table, to which only a few remarks need be added. If the number of main radial canals is larger than the number of stomachal lobes, it means that two or more canals issue from one or more of the lobes; three of the specimens with ten main canals are very regular in shape, two canals issuing from each of the five stomachal lobes; in one of these specimens the thirty-five tentacles are distinctly seen to belong to four different stages in development: 5+5+10+15.

Willia mutabilis. *Table showing variation in the number of radial canals, etc.*

Specimens with radial canals regularly arranged				
No. of main radial canals	No. of branches to the main radial canals	No. of lobes to the stomach	Average no. of tentacles + young bulbs (*b*)	Diameter of umbrella, mm.
8	0	4	4 + 4*b*	1
8	0–1	4	8 + 4*b*	1¼
8	1	4	16	1–2½
8	2	4	24	2–4
8	2–3	4–8	28	2½–4½
8	3	4–8	32	3–4½
8	3–4	4–8	36	3–4½
8	4	8	40	4½–5
6	2	6	12 + 6*b*	1½
6	3	6	12 + 12*b*	1½–2
6	3	6	24	2–3
6	3–4	6	27	3–4½
6	4	6	30	4–5
6	5–6	6	39	5
6	6	6	42	5
6	6–10	6	54	6

Irregular specimens				
No. of main radial canals	No. of branches to the main radial canals	No. of lobes to the stomach	No. of tentacles	Diameter of umbrella, mm.
5	3–8	5	34	4½
6	2–7	4	32	3½
6	?	5	27	3½
7	Irregular	5	24	2½
7	Irregular	5	37	6
7	2–4	6	28	4
7	3–6	6	39	5
7	3	7	28	2
7	3	7	28	2
8	1	5	16	2
8	3	6	32	3½
8	3	7	29	3½
8	2–3	7	32	4
8	3–4	7	42	4½
9	?	5	28	3
9	?	7	33	4½
10	1	5	20	3
10	2–3	5	35	4
10	2	5	30	4
10	2	6	30	3
10	?	8	49	4½
11	?	10	35	6

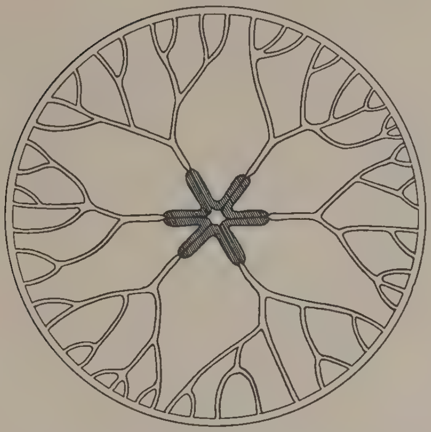

Fig. 8. *Willia mutabilis.* The radial canal system of an adult having a stomach with six lobes.

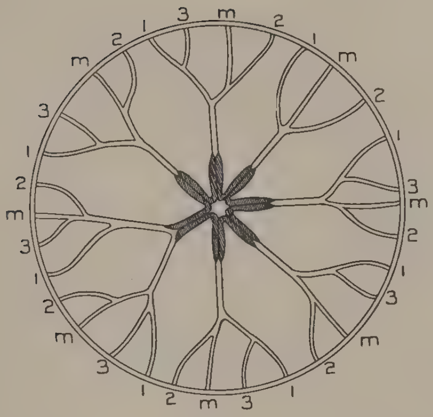

Fig. 9. *Willia mutabilis.* The radial canal system of an adult having a stomach with seven lobes, but one lobe has two main canals.

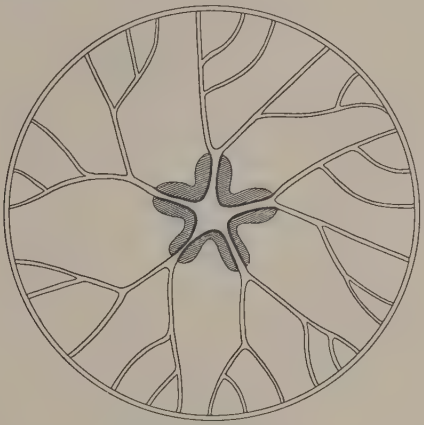

Fig. 10. *Willia mutabilis.* The radial canal system of an adult having a stomach with five lobes, four of which have two main canals.

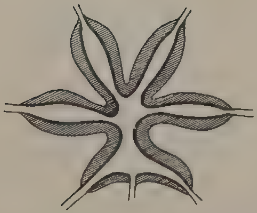

Fig. 11. *Willia mutabilis.* A stomach with five lobes, with one lobe enlarged and having three main canals.

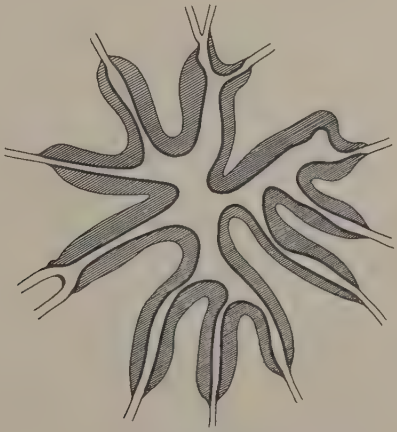

Fig. 12. *Willia mutabilis.* A stomach with ten lobes, arranged in a very irregular manner. The canal system is also very irregular.

Apart from the number of radial canals and lobes to the stomach there is nothing to indicate that the specimens with eight main radial canals are specifically different from the six-rayed specimens, and the occurrence of several with five, seven, nine, ten or eleven main canals further confirms the supposition that the examples of *Willia* at the Falkland Islands all belong to one species, the most characteristic feature of which is its extreme variability. The six-rayed specimens are so much like *W. stellata* that they might be considered to belong to that species. In *W. stellata*, however, six is the absolutely dominating number of rays, and specimens with other numbers are altogether irregular in shape; eight main radial canals regularly arranged are never seen in this species, whereas it is the number most commonly found in the Falkland medusa. It seems reasonable, therefore, at least provisionally, to regard *W. mutabilis* as a proper species. There also seems to exist some difference in the mode of branching of the radial canals. In *W. stellata* the two first lateral branches are opposite each other, issuing on either side of the main canal and fairly close together. In *W. mutabilis*, regardless of the number of main canals, the two first branches come off rather far from each other and frequently both on the same side of the main canal, or the second branch comes off from the first one and not from the main canal itself. *W. stellata* occurs in northern Europe and in Japan. Another Japanese species, *W. pacifica* Maas, has likewise six main radial canals; it is distinguished from *stellata* by the much greater number of terminal branches and tentacles; Uchida (1930, p. 334) considers it a proper species. A very interesting species is *W. brooksi* Mayer (1910, p. 194) from Beaufort, N.C., in North America; it has six main radial canals, but the stomach is not divided into six equal lobes but forms three lobes each of which is bifurcated, in the same manner as the four primary lobes in young specimens of *W. mutabilis* with eight main canals as described above. This species further demonstrates the variability in the conformation of the medusae within this genus.

The genus *Proboscidactyla* is characterized by the number of main radial canals and lobes to the stomach being four and not six or more as in *Willia*. As demonstrated above, however, when eight main canals are found in *W. mutabilis* they are not of equal origin, and the fundamental number is really four, as in *Proboscidactyla*. If in a *Proboscidactyla* the four stomachal lobes, with the gonads, were to proceed with their outward growth beyond the first division of the main radial canals, the medusa would attain an appearance very like that of the intermediate stages of *Willia mutabilis* with eight main canals. Such prolongation of the stomachal lobes has actually been observed in specimens of *Proboscidactyla ornata* var. *stolonifera* from the west coast of Mexico (Bigelow, 1909, p. 220, pl. 41, figs. 1–7) and in *P. varians* Browne from India. Accordingly, the limit between the two genera *Willia* and *Proboscidactyla* is not so sharp as formerly supposed.

Menon (1932, p. 13) has described a medusa from Madras in India which he called *Proboscidactyla conica*. The stomach is cross-shaped in transverse section and has several radial lobes; there are several branched radial canals and thirty-five to forty-five tentacles. The specimen figured (pl. ii, figs. 12–13) bears a striking resemblance to irregular specimens of *Willia mutabilis*.

Since *W. mutabilis* was first described from the Falkland Islands (Browne, 1902) it has been recorded once from the same locality (Browne, 1908) and recently (Thiel, 1938) from two localities in South America: Patagonia Bank and north-east of Puerto Madryn. Vanhöffen (1912 *b*) also records it, though with some doubt, from Punta Arenas in the Strait of Magellan, where several young specimens were found. According to Vanhöffen a small tentacle was present between every two of the larger tentacles which are opposite the terminal ends of the branched radial canals, whereas he failed to see any canals leading to the small tentacles. As stated above, the canals leading to very young tentacular bulbs may be very difficult to see, and it seems probable that they have actually been present in Vanhöffen's specimens, though he has not observed them. Those from Punta Arenas were all six-rayed; nevertheless, considering the area where they were found, it seems probable that they really belonged to *W. mutabilis*.

Family MOERISIIDAE

Genus Tiaricodon Browne (1902)

GENERIC CHARACTERS. Moerisiidae with four perradial tentacles. Stomach with four perradial lobes extending along a broad peduncle; mouth with four distinct lips. Gonads upon the stomach and its lobes.

This genus was erected for the species *Tiaricodon coeruleus* from the Falkland Islands and was originally referred to the Tiaridae, subfamily Protiarinae. Mayer (1910, p. 73) was inclined to refer *T. coeruleus* to the genus *Corynitis* (the name changed into *Linvillea*, p. 719, because *Corynitis* was preoccupied) among the Codonidae. In *Linvillea*, however, the gonads are entirely restricted to the lateral walls of the stomach, forming four deep, interradial grooves, but not extending along the radial canals, and the structure of the tentacles is quite different from that of *Tiaricodon*. Vanhöffen (1912 *b*, p. 6), who had examined some specimens of *T. coeruleus* from South America and cut sections of the manubrium, likewise referred the species to the Codonidae and placed it in the same genus as *Corynitis* (*Linvillea*) *agassizii* McCrady, but retained the generic name *Tiaricodon*. As a matter of fact, *Tiaricodon* is essentially like a large *Moerisia* or *Caspionema* and is only distinguished from these genera by the possession of a short stomachal peduncle and four distinct oral lips armed with nematocysts. In the present paper it is, therefore, referred to the Moerisiidae.

Tiaricodon coeruleus Browne (Plate XVIII, figs. 1–6; Plate XIX, figs. 8–11).

Tiaricodon coeruleus Browne, 1902, p. 276.
Corynitis (?) *coerulea* Mayer, 1910, p. 73.
Tiaricodon caeruleus Vanhöffen, 1912*b*, p. 6, Taf. I, fig. 2; Taf. II, figs. 2–6.

SPECIFIC CHARACTERS. *Adult:* Umbrella bell-shaped, with a rounded summit, about as high as broad; gelatinous substance thick, especially at the apex. Exumbrella smooth and not covered with nematocysts. Velum narrow. Stomach a quadrangular tube extending down nearly to the velum, and situated on a short, broad peduncle, forming four large perradial, sac-like lobes. Mouth with four perradial lips, about as wide as the stomach; margin crenulated, with small warts containing nematocysts. Gonads surrounding the basal part of the stomach and extending over the peduncle along the four perradial lobes of the stomach. Tentacles four, perradial, fairly stout and tapering to a point, nematocyst clusters in the distal part of the tentacle forming distinct transverse bands. Basal bulbs large, cylindrical, a little longer than broad. An ocellus on the outer (abaxial) side at the base of each tentacle. *Colour:* Stomach, gonads, and basal bulbs pale yellow (in formalin), ocelli reddish brown. (Radial canals, gonads, manubrium, and tentacles bright blue when alive, according to note by R. Vallentin.) *Size:* Umbrella 25 mm. in height and 24 mm. in width (largest specimen). Vallentin has seen living specimens 30 mm. in height.

The first collection contains twelve specimens, showing the early, intermediate, and adult stages; they were collected in Stanley Harbour between 11 November and 27 December 1898. In the second collection there are thirty-two specimens from Stanley Harbour, where the species was observed from 7 November 1901 to 21 March 1902. Those from November are all large, but from the beginning of January young and intermediate stages as well as adults were found. Vanhöffen records this species from Callao on the coast of Peru and from the Strait of Magellan.

In the earliest stage observed (Plate XVIII, fig. 3) the umbrella is bell-shaped, 1 mm. in height and $\frac{3}{4}$ mm. in width. Velum broad. Stomach quadrangular, without perradial lobes and not mounted on a peduncle, about one-third the length of the umbrella cavity. Mouth with four short lips, scarcely visible. Gonads not developed. Tentacles short and stout, with large globular or cylindrical basal bulbs. This early stage resembles a little *Sarsia*, but is distinguished by the structure of the tentacles and basal bulbs and by the quadrangular shape of the stomach.

As the medusa grows, the manubrium increases in length and becomes tube-like; the perradial lobes appear at its base (Plate XVIII, fig. 2), and when fully developed extend along the whole peduncle, but not beyond it. In the intermediate stages the length of the manubrium is very variable. Soon after the lobes start to develop (when the umbrella is about $2\frac{1}{2}$ or 3 mm. high), the peduncle begins to form. The lobes in the intermediate stages are thin and narrow, but in the adult they become sac-like, their distal ends hanging down into the umbrella cavity, just as in a *Moerisia*. When viewed aborally they form a distinct perradial cross (Plate XVIII, fig. 6). In the early stages the mouth is like that of *Moerisia*, being either round or quadrangular, the lips scarcely visible. In the intermediate stages the four perradial lips are distinctly visible, but scarcely exceed in width the diameter of the stomach. In the adult the lips are slightly wider than the stomach and the margin is crenulated and provided with small clusters of nematocysts (Plate XVIII, fig. 5). The radial canals are large and conspicuous in all stages, and also the ring canal.

The gonads occupy the lobes of the stomach and also extend about half way down the manubrium. They form a continuous mass, not separated by perradial or interradial grooves (Plate XVIII, fig. 6). This was seen by Vanhöffen in the South American specimens examined by him, and it is confirmed by sections of Falkland specimens.

When closely contracted the tentacles are little longer than the height of the umbrella, rather stout, and gradually tapering in thickness towards the pointed tip; they are thickly covered with nematocysts in minute papillae (Plate XVIII, fig. 4). When expanded, the tentacles are several times as long as the height of the umbrella and very thin in the greater part of their length, but in the preserved specimens the proximal part of the tentacles, beyond the basal bulbs, is always stout and conical. The clusters of nematocysts in the proximal part of the tentacle form small, rounded warts, closely set; towards the distal part these warts gradually become broader, crescent-shaped, clasping around one half to three-quarters of the circumference of the tentacle, and in the outermost part, near the tip of the tentacle, they form complete transverse bands. There is also a bullet-shaped terminal cluster, slightly expanded. The crescent-shaped clusters are thick in their middle part, tapering towards both sides, and they are wedged in between each other without any definite arrangement. The tentacles are hollow throughout their length (Plate XIX, figs. 8, 11), though in the distal part the central cavity is narrow. Such hollow tentacles with nematocysts in distinct transverse bands, more or less completely surrounding the tentacle, are found in all members of the three families belonging to the Limnomedusae.

The basal bulbs of the tentacles (Plate XVIII, fig. 4) are large and cylindrical or, in a contracted state, somewhat barrel-shaped, a little longer than broad. They have a smooth surface, and very few nematocysts are found in the superficial layer of the ectoderm; but in the deeper part of the ectodermal epithelium, close to the supporting lamella, there are numerous nematoblasts (Plate XIX, figs. 8, 10), from which, presumably, the tentacle is continually provided with new nematocysts. The basal bulbs are attached to the margin of the umbrella by a narrow base (Plate XVIII, fig. 4) and do not extend into the substance of the umbrella.

There is one large, cup-shaped ocellus at the base of each tentacle, on the outer (abaxial) side (Plate XIX, fig. 9). The ocellus is not on the basal bulb itself, but on a special papilla (Plate XIX, fig. 8) wedged in between the basal bulb and the margin of the umbrella (as in *Moerisia*). This papilla is attached to the wall of the exumbrella and is well above the basal bulb. Inside the ocellar papilla the cavity of the basal bulb forms a hook-like, hollow, endodermal prolongation.

One large abnormal specimen was found on 11 November 1901. The stomach has only three lobes, but one of these gives rise to two radial canals, making four radial canals in all. Moreover, the manubrium is double, two equally developed mouth tubes issuing from two of the lobes of the stomach.

Vallentin's notes contain some very interesting observations on the living specimens of *Tiaricodon coeruleus*: "11 November 1898: This species is very easily seen in the water. Radial canals, gonads, manubrium, and tentacles bright blue in colour. The tentacles stream away from the umbrella to an enormous distance. A prominent eye-spot can be easily seen at the base of each tentacle." "30 November 1898: Abundant. The large specimens very attractive. The normal position of this medusa is an upright one in the water, a few inches beneath the calm surface of the sea. It seldom moves, but extends its tentacles as far as possible, and they can cover an enormous area." "16 January 1902: Several specimens of this species were placed in a large bell jar filled with fresh sea-water, and a number of copepods were turned in with them. As soon as a copepod was seized with one of the tentacles, it was conveyed to the mouth by the shortening of the tentacle, and the umbrella would also become contracted near the place surrounding that tentacle, the manubrium at the same time being directed towards the food. There seemed to me great intelligence displayed by these medusae while feeding." Vallentin also remarks that the manubrium in the living animal usually extends to the edge of the umbrella cavity and only occasionally beyond it.

Family OLINDIIDAE

Genus **Aglauropsis** Fritz Müller (1865)

Generic characters. Olindiidae without centripetal canals; with numerous enclosed marginal statocysts. Numerous tentacles, evenly distributed round the margin of the umbrella and not arranged in groups; tentacles without adhesive pads.

The genus *Aglauropsis* was founded by Fritz Müller (1865) for a medusa found on the coast of Brazil. The description of the species (*Aglauropsis agassizii*), the only species of the genus, is so vague and so imperfect that it just defines the generic characters and no more. The description is given in a paper "Ueber die Randbläschen der Hydroidquallen", and there is a poor figure of a statocyst. It would not be safe to use the specific name for the Falkland medusa, as it would imply that the Falkland species occurred on the coast of Brazil. The safest place for the Brazilian species would be the obsolete list, for it is practically undescribed.

Aglauropsis is distinguished from *Olindias* Fr. Müller, *Maeotias* Ostroumoff, and *Eperetmus* Bigelow by the absence of centripetal canals from the ring canal, and from *Gonionemus* L. Agassiz and *Cubaia* Mayer by the absence of adhesive pads on the tentacles.

Aglauropsis conantii Browne (Plate XVIII, figs. 7–16).

Aglauropsis conantii Browne, 1902, p. 283.
Aglauropsis conantii Browne, 1904, p. 736.
Aglauropsis conantii Browne, 1905, p. 151.
Aglauropsis conantii Mayer, 1910, p. 362.

Specific characters. *Adult* (Plate XVIII, fig. 7): Umbrella bowl-shaped, with an inverted margin, a little broader than high; gelatinous substance thick. Stomach somewhat cone-shaped, about half to two-thirds the length of the umbrella cavity. Mouth with four large, perradial lips, having a folded margin with a band of nematocysts. Radial canals and ring canal very broad. Gonads occupying nearly the whole length of the radial canals, but separated by a short space from the stomach and also from the ring canal, transversely divided into lobes. Tentacles very numerous, about 200, closely packed in two or three alternating rows round the margin. Statocysts internal, adjoining the ring canal, about fifty or more, each with a single statolith. *Colour:* Stomach, gonads, and basal bulbs pale yellow (in formalin or alcohol). *Size:* Umbrella about 22 mm. in width and 14 mm. in height (largest specimen).

The first collection contains about 150 specimens, taken in Stanley Harbour from November 1898 to February 1899, showing a fine series from the early stages up to the fully grown adult. In the second collection there are about forty-five specimens, likewise from Stanley Harbour, collected from 6 November 1901 to 27 March 1902; young specimens were present during the whole of this period and adults were found from 26 December.

Measurements of some of the larger specimens: diameter 14 mm., height 10, 11, 12 mm.; diameter 15 mm., height 13 mm.; diameter 17 mm., height 10, 13 mm.; diameter 18 mm., height 11, 14, 15 mm.; diameter 19 mm., height 13 mm.; diameter 20 mm., height 12, 13, 14, 14, 15, 18 mm.; diameter 21 mm., height 15 mm.; diameter 22 mm., height 13, 14 mm.

The umbrella of all the stages is very thick and solid; its proportions vary very much, but there is a distinct tendency to broaden as it grows. In the earliest stages observed, 1–1¼ mm. wide, it is bell-shaped and usually a little higher than wide; in the intermediate stages it is frequently somewhat globular. In very early stages several nematocysts are seen scattered over the exumbrella. The velum is very broad in the early stages, but gradually becomes less conspicuous.

The stomach in the early stages is fairly short, one-quarter to one-half the length of the umbrella cavity, and has a quadrangular base, but in the adult the four radial canals form a distinct cross over the base of the stomach (Plate XVIII, fig. 11). When expanded the stomach is like a small globular or conical bag with thin walls, but when contracted it becomes cross-shaped in transverse section (Plate XVIII, fig. 12). The mouth in the early stages has four small, simple perradial lips, which increase in size as the medusa grows, and its margin becomes folded. There is a band of nematocysts round the mouth rim.

The gonads commence to develop when the umbrella is about 2 mm. in width, and are then continuous with the stomach wall (Plate XVIII, fig. 9), just as in the Moerisiidae and in *Ostroumovia* among the Olindiidae, giving further evidence of the relationship between these two families. The gonads gradually grow down the radial canals nearly to the ring canal, and become separated from the stomach (Plate XVIII, fig. 11). At first they form a narrow, simple band, which gradually becomes folded (Plate XVIII, fig. 8). In the adult the gonads are divided by numerous deep transverse furrows, and the ridges between the furrows become lobed (Plate XVIII, fig. 10). The gonads are not divided in the median line on the lower side.

When the diameter of the umbrella is 3–5 mm., the gonads are about one-quarter to one-third the length of the radial canals and still adjacent to the stomach; diameter 5–6 mm., gonads about one-half to two-thirds the length of the radial canals, not folded; diameter 8–10 mm., gonads about two-thirds to three-quarters the length of the radial canals, slightly folded. The radial canals, and especially the ring canal, are very broad in all stages.

The tentacles are hollow and are closely crowded together round the margin. Each tentacle has a small oval basal bulb attached to the margin of the umbrella, and the tentacle itself is also for a short distance attached to the margin (Plate XVIII, fig. 14). The older tentacles have a longer attachment than the younger ones so that two or three alternating series are formed. Each tentacle is covered with nematocysts (Plate XVIII, figs. 15, 16) arranged in transverse bands, which either nearly surround the tentacle or are slightly spiral. The largest specimens all have about 200 tentacles, and nearly all of them are fully developed, only very few young tentacles being found between them; presumably, therefore, 200 is about the maximum number of tentacles developed in this species.

The statocysts are internal, inside the margin of the umbrella and adjacent to the ring canal (Plate XVIII, fig. 14). Owing to the opaqueness of the ring canal the statocysts are not easily seen and are often difficult to find. The early stages have four statocysts, adradially situated; in the next stage there are eight, adradial, two being in each quadrant. The number increases with age and they are irregularly scattered round the margin; usually one is present near the base of every third or fourth tentacle. The statocysts lie between the tentacles, adjacent to and on the outer side of the ring canal (Plate XVIII, fig. 13). Each one has a single statolith on a short, endodermal stalk inside a small roundish vesicle.

Diameter of umbrella mm.	No. of tentacles	No. of statocysts
1–1½	About 24–36	4
1½–2½	About 48–64	4–8
3–5	About 64–80	About 8–24
5–6	About 80–120	About 16–40
8–10	About 140–180	About 35–40
12–22	About 200	50 or more

According to Mr Vallentin's notes *Aglauropsis conantii* occurs in great quantities in Stanley Harbour; especially between 24 January and 3 February 1899 he repeatedly wrote in his notes: "Surface of the sea swarming with specimens", "Shoals seen", "Quantities seen floating about".

This species is dedicated to the memory of Franklin Story Conant of Johns Hopkins University, who died of yellow fever contracted through self-sacrificing devotion to others whilst engaged on the study of the Cubomedusae of Jamaica, 1897.

Genus Vallentinia Browne (1902)

Generic characters. Olindiidae with four simple radial canals, without blind centripetal canals between them. Sixteen (or more) enclosed marginal statocysts. Four large, hollow, perradial tentacles, each with a terminal adhesive disk, and twenty-four (or more) hollow tentacles evenly distributed on the margin, without adhesive disk, but with bands of nematocysts.

This genus, which is named after Mr Rupert Vallentin, has a well-marked character in the presence of four large perradial tentacles with a terminal adhesive disk. Without these modified tentacles the medusa would have all the generic characters of an *Aglauropsis*. The genus only comprises one species.

Vallentinia falklandica Browne (Plate XVIII, figs. 17–19; Plate XIX, figs. 6, 7).

Vallentinia falklandica Browne, 1902, p. 284.
Vallentinia falklandica Mayer, 1904, p. 20.
Vallentinia falklandica Browne, 1904, p. 738.
Vallentinia falklandica Maas, 1906, p. 19.
Vallentinia falklandica Mayer, 1910, p. 352.

SPECIFIC CHARACTERS. *Adult* (Plate XVIII, fig. 17): Umbrella bell-shaped, about 1½ times as high as broad. Stomach short, about one-third the length of the umbrella cavity, not situated on a peduncle. Mouth with four short simple lips, the mouth rim provided with nematocysts. Radial canals four. Gonads situated on the radial canals in the upper half of the umbrella cavity, a little way below the stomach, oval and sac-like. Tentacles four large perradial with scattered nematocysts and with terminal adhesive disks, and twenty-four (six in each quadrant evenly distributed) with transverse bands of nematocysts. Sixteen vesicular statocysts enclosed inside the margin of the umbrella, each with a single statolith. Velum very broad. *Colour:* Gonads and stomach pale yellow (in formalin). *Size:* Umbrella 3 mm. in height and 2 mm. in width.

In the first collection there was only a solitary specimen of this most interesting medusa, taken on 11 December 1898 in Sparrow Cove in Port William Bay, which is just outside Stanley Harbour. The third collection contains a specimen, taken on 8 November 1909, and ten specimens taken on 4 December 1909 (exact localities not stated); they are somewhat smaller than the type specimen, being 2–2½ mm. in height and 1½–2 mm. in width (Plate XIX, figs. 6, 7).

The perradial tentacles with adhesive disks indicate that the medusa must have a special use for them, and presumably it has adapted itself for living amongst the kelp, which forms marine forests round the shores of the Falklands. The tentacles would be used for clinging on to the branches of the kelp, and the medusa's mode of life would resemble that of *Cladonema*, which lives amongst the *Zostera* on the British coasts.

As long as this medusa was only known from the original brief description (Browne, 1902), its specific value has been doubted. Maas (1906) designates it as "Larvenform von umbestimmter Zugehörigheit", and Mayer (1910) suspects that it may prove to be an immature stage of some *Olindias*. As a matter of fact, it is a well-defined species, representing a well-marked genus, and quite distinct from *Olindias* and from any other genus of the Olindiidae.

In the exumbrella there are several scattered nematocysts. The walls of the umbrella are moderately thick in all parts; the umbrella cavity is somewhat quadrangular in transverse section.

The manubrium is not on a peduncle; it is small, in most specimens it is cylindrical or prismatic, in one specimen it is barrel-shaped (Plate XIX, fig. 6), somewhat constricted immediately above the mouth, which is expanded, quadrangular, with a cross-shaped orifice, and with four short lips just indicated. The mouth rim is not folded, but carries a narrow band of nematocysts. The radial canals are tube-like and conspicuous; the ring canal is very broad.

The gonads are oval hollow sacs, hanging down from the radial canals. In the type specimen the ova are fairly large, but not quite ripe, and the gonads are separated from the base of the stomach by about their own length (Plate XVIII, fig. 17). In the smallest specimens the gonads are very small, almost globular in shape, and placed very close to the base of the stomach (Plate XIX, figs. 6, 7), indicating that in still younger stages they are in direct connection with the stomach wall, as in *Aglauropsis* and *Ostroumovia*. The gonads are not divided in the median line on the lower side.

The tentacles (Plate XVIII, fig. 18) are more or less contracted. The perradial tentacles are about twice as broad as the ordinary tentacles, of equal thickness throughout their length. They are hollow, with a central cavity about one-third the diameter of the tentacle, surrounded by a thick endodermal epithelium. The ectoderm, which contains some few scattered nematocysts, is very thin except at the apex which is developed into a powerful adhesive disk, vaulted or sometimes concave in shape, and with slight furrows (Plate XVIII, fig. 19). The ordinary tentacles are twenty-four in number in all specimens; in most of them they are more or less curved inward, but in a few specimens they are moderately extended and are then a little longer than the perradial tentacles; they taper gradually in thickness from the base towards the tip, and contain a central cavity except in their outermost portion, where the endoderm is solid, consisting of one row of cells. These tentacles have numerous bands of nematocysts, forming high transverse ridges; but the ridges are only on the outer side of the tentacle, clasping round one-half to three-fourths of its circumference, and not extending quite over the inner side. There is also a very small terminal cluster at the end of the tentacle. At the base of all the tentacles, including the perradial, there is a basal bulb, situated on the inner side (Plate XVIII, fig. 18). The bulb is fairly large, globular, and probably contains nematocysts. The outer side of the tentacle, opposite to the basal bulb, is attached to the margin of the umbrella. The arrangement and the shape of the basal bulbs are like those of *Aglauropsis*, *Gonionemus*, and other genera of Olindiidae.

The statocysts are at the base of the tentacles, adjacent to the ring canal (Plate XVIII, fig. 17). In the type specimen fifteen statocysts could be counted, but probably sixteen are present. To judge from their size, it is suggested that the medusa has only four statocysts in its earliest stage, then eight, and the others appear later between the previous ones; this supposition is confirmed by the smaller specimens, in which only two statocysts could be detected in each quadrant, one large and one very small. The statocyst is a circular vesicle with a single statolith. The position, size, and appearance of the statocysts are similar to those in *Aglauropsis*.

The velum is very broad, its central opening being scarcely one-third of the diameter of the umbrella margin.

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PLATE XIV

Figs. 1–2. *Sarsia gracilis* Browne.

Fig. 1. Lateral view of an adult.

Fig. 2. Earliest free-swimming stage. Tentacles contracted.

Figs. 3–4. *Staurocladia vallentini* (Browne).

Fig. 3. Type-specimen. Aboral view.

Fig. 4. Type-specimen. Lateral view of crawling medusa.

Fig. 5. *Rathkea formosissima* (Browne). Lateral view of an adult with ova and planulae attached to the stomach.

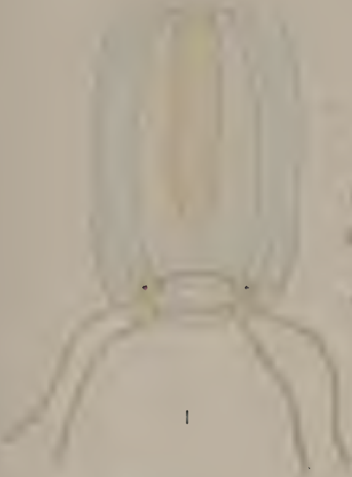
Fig. 6. *Bougainvillia macloviana* Lesson. Lateral view of a large adult.

Fig. 7. *Halitholus intermedius* (Browne). Lateral view of an intermediate stage.

Figs. 8–9. *Willia mutabilis* Browne.

Fig. 8. Lateral view of an adult.

Fig. 9. Exterior (abaxial) view of a tentacle.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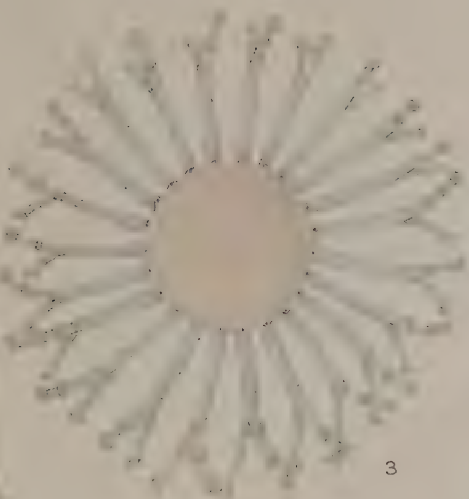
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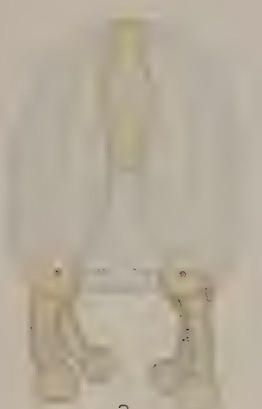
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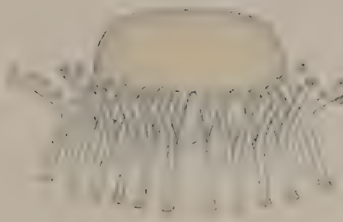
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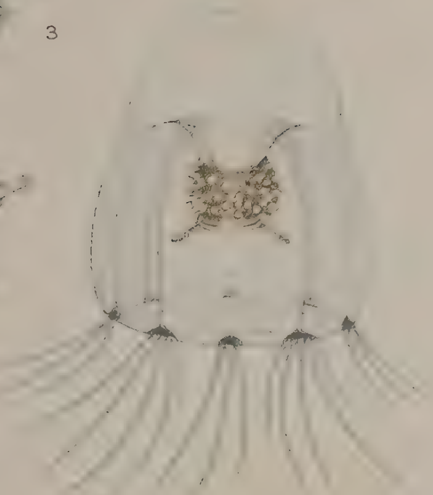
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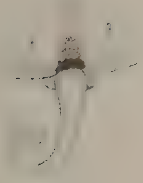
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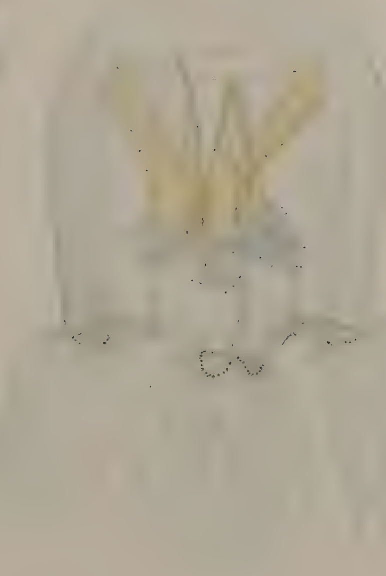
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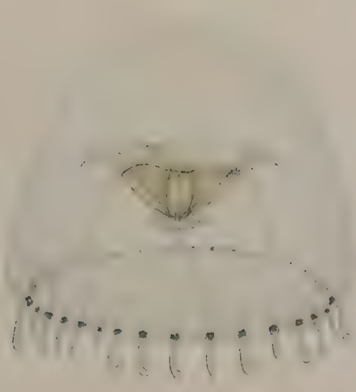
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MEDUSAE FROM THE FALKLAND ISLANDS

PLATE XV

Fig. 1. *Sarsia gracilis* Browne. Lateral view of a tentacle belonging to an adult.

Figs. 2–3. *Hybocodon unicus* (Browne).

Fig. 2. Lateral view of the medusa.

Fig. 3. Diagram of the margin of the umbrella. Oral view.

Fig. 4. *Staurocladia vallentini* (Browne). Lateral view of a tentacle; type-specimen.

Figs. 5–6. *Podocoryne tenuis* (Browne).

Fig. 5. Lateral view of medusa, with medusa-buds.

Fig. 6. Mouth expanded.

Figs. 7–14. *Bougainvillia macloviana* Lesson.

Fig. 7. Lateral view of an intermediate stage.

Fig. 8. Lateral view of a very early stage.

Fig. 9. A transverse optical section of the umbrella of a young stage, showing the interradial and perradial furrows in the umbrella, and the internal adradial ridges.

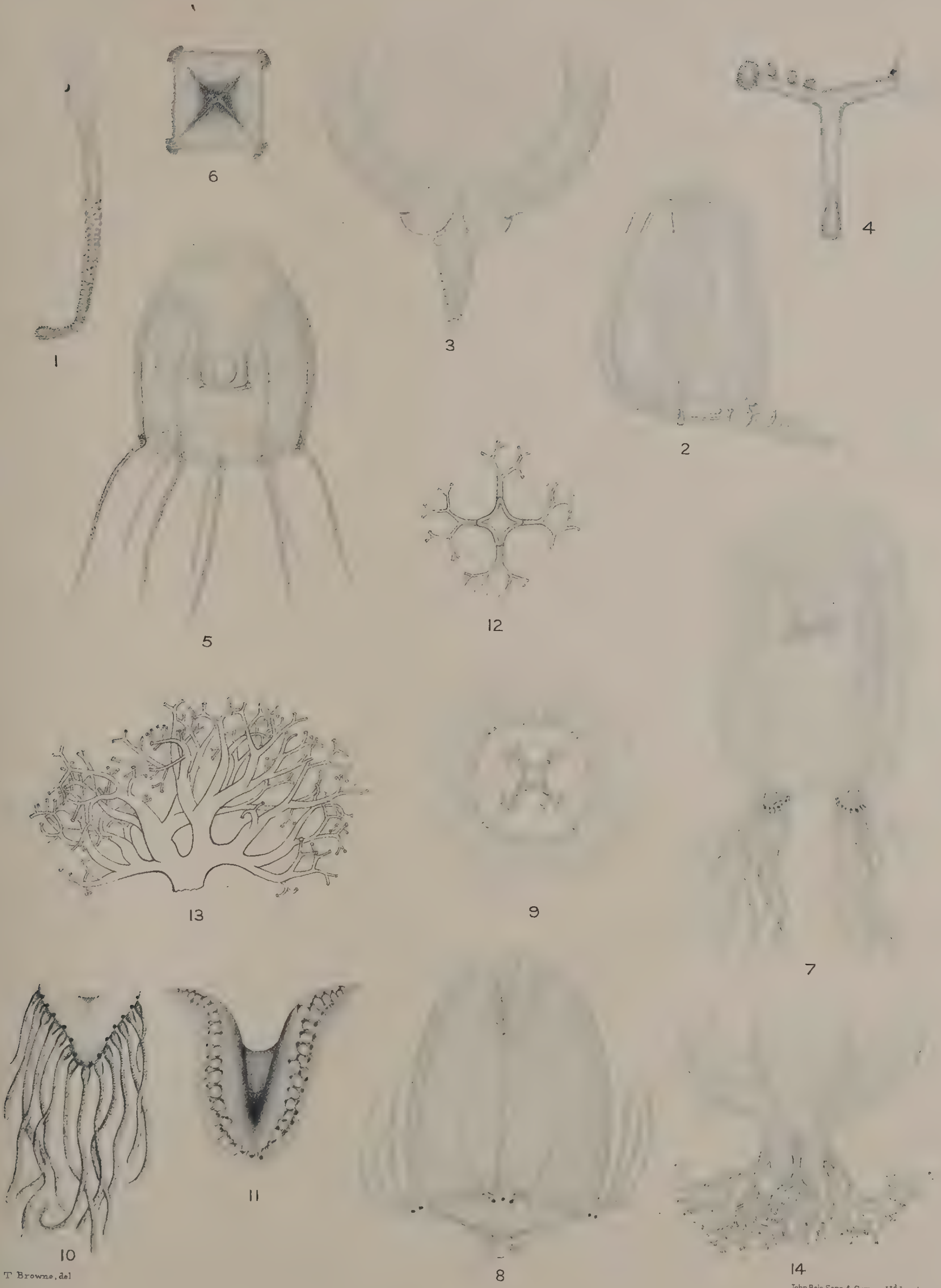
Fig. 10. A compound basal bulb, with a single row of tentacles. Intermediate stage. Oral view.

Fig. 11. A compound basal bulb, with a double row of tentacles (which are vigorously contracted), of a fully grown adult. Oral view.

Fig. 12. The oral tentacles of an early stage.

Fig. 13. An oral tentacle of a fully grown adult (umbrella 12 mm. in length and width).

Fig. 14. Lateral view of the oral tentacles showing their relation to the mouth.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MEDUSAE FROM THE FALKLAND ISLANDS

PLATE XVI

Figs. 1–2. *Halitholus intermedius* (Browne).

Fig. 1. Lateral view of an early stage.

Fig. 2. A tentacle, lateral view, contracted.

Figs. 3–5. *Laodicea pulchra* Browne.

Fig. 3. Oral view of an adult, showing the margin of the umbrella, the stomach with lobes, and the mouth.

Fig. 4. Aboral view of an adult, showing the gonads on the lobes of the stomach.

Fig. 5. The tentacles with the marginal clubs (cordyli) and ocelli (velum removed). Inner (adaxial) side. *rc*, ring-canal.

Figs. 6–8. *Obelia multicia* Browne.

Fig. 6. Oral view of an adult, male.

Fig. 7. A tentacle, showing the outer (abaxial) side.

Fig. 8. An ovary.

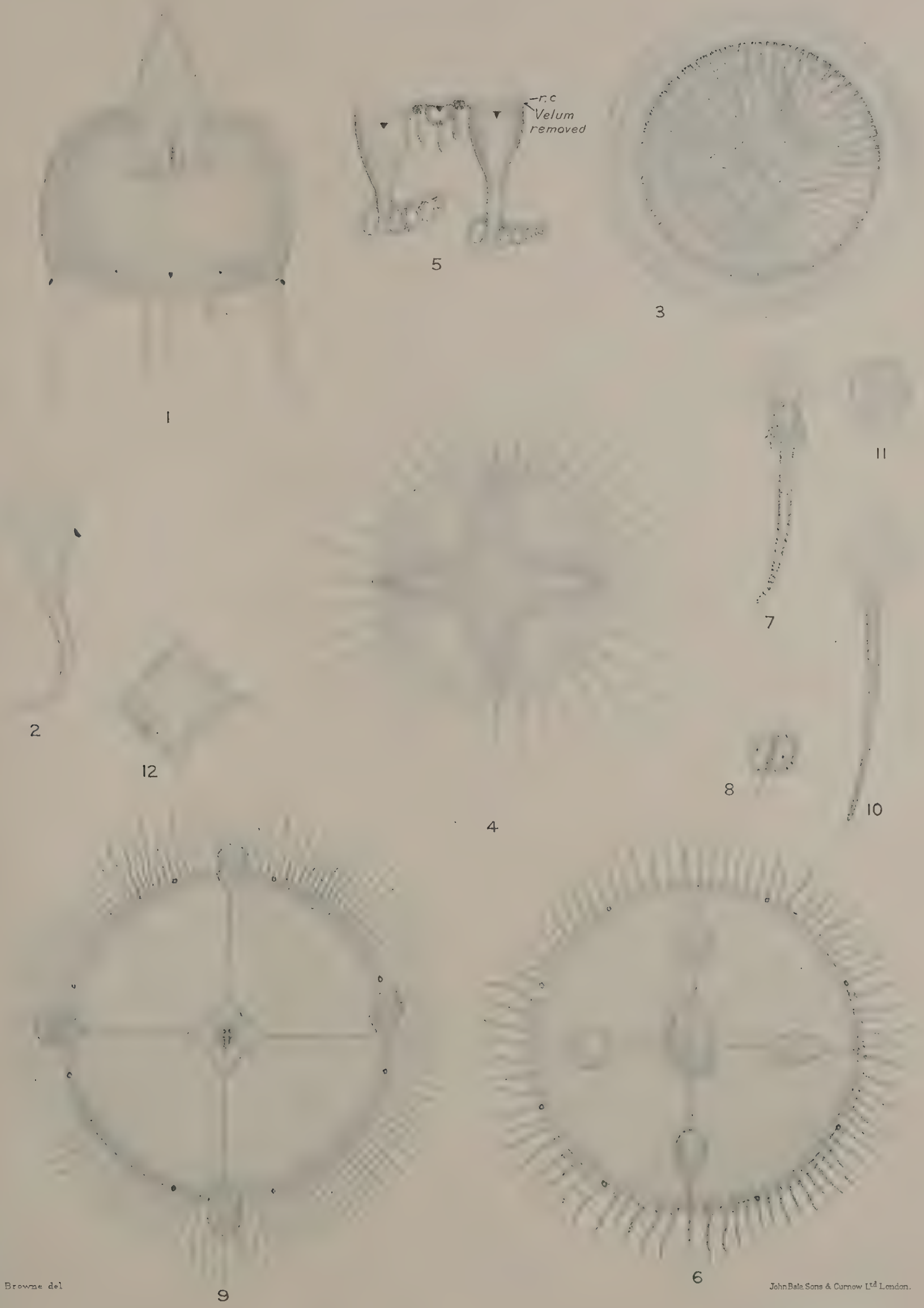
Figs. 9–12. *Obelia* sp.

Fig. 9. Oral view of an adult, female.

Fig. 10. A tentacle, showing the outer (abaxial) side.

Fig. 11. An ovary, lateral view.

Fig. 12. The base of the stomach, aboral view.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MEDUSAE FROM THE FALKLAND ISLANDS

PLATE XVII

Fig. 1. *Cosmetirella davisi* (Browne). Lateral view of an adult.

Figs. 2–4. *Phialella falklandica* Browne.

Fig. 2. Lateral view of an adult.

Fig. 3. An intermediate stage.

Fig. 4. A statocyst.

Figs. 5–9. *Phialidium simplex* Browne.

Fig. 5. Intermediate stage, oral view.

Fig. 6. An adult, lateral view.

Fig. 7. Margin of the umbrella, showing tentacles and statocysts, outer (abaxial) view.

Fig. 8. The mouth of an adult.

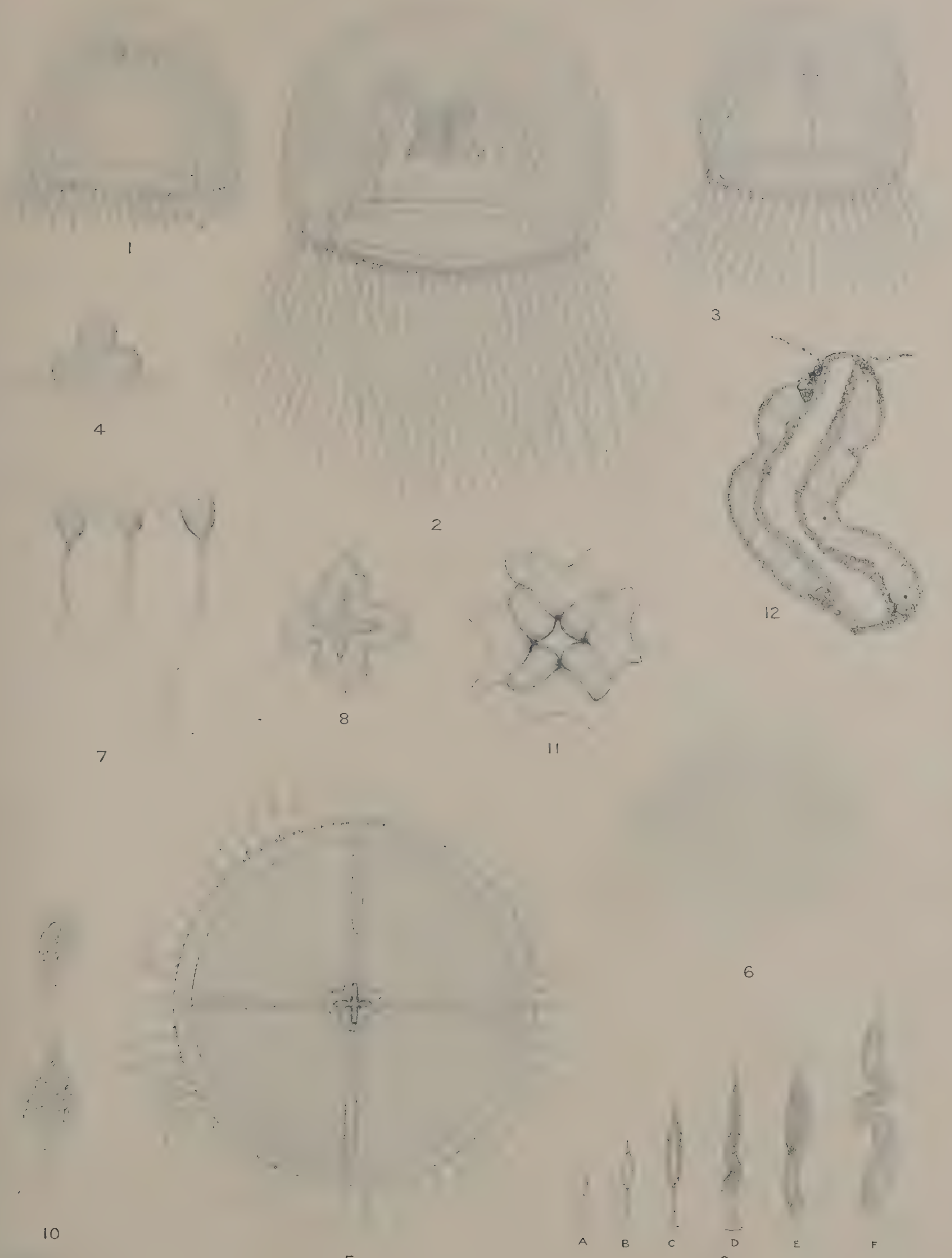
Fig. 9. Diagrams showing the growth of the ovaries. *A*, umbrella 3 mm. in diameter; *B*, 4 mm.; *C*, 6 mm.; *D*, 10 mm.; *E*, 15 mm.; *F*, 20 mm.

Figs. 10–12. *Willia mutabilis* Browne.

Fig. 10. The clusters of nematocysts on the exumbrella, near the margin.

Fig. 11. The mouth expanded, of an early stage, showing the lips, and commencement of the folds.

Fig. 12. Transverse section of ovary.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MEDUSAE FROM THE FALKLAND ISLANDS

PLATE XVIII

Figs. 1–6. *Tiaricodon coeruleus* Browne.

Fig. 1. Lateral view of an adult.

Fig. 2. Lateral view of an intermediate stage.

Fig. 3. Lateral view of an early stage.

Fig. 4. A tentacle, contracted, belonging to an adult, outer (abaxial) view.

Fig. 5. The mouth and its folded margin. Adult.

Fig. 6. Aboral view of the stomach, showing the four lobes bearing gonads, upon the peduncle. Adult.

Figs. 7–16. *Aglauropsis conantii* Browne.

Fig. 7. Lateral view of a large adult.

Fig. 8. Lateral view of an intermediate stage.

Fig. 9. Lateral view of an early stage.

Fig. 10. A gonad of an adult.

Fig. 11. The base of the stomach when expanded.

Fig. 12. The base of the stomach when contracted.

Fig. 13. Radial section of a statocyst.

Fig. 14. A diagrammatical section of the margin, showing the position of the tentacles and the statocyst. *ex*, exumbrella; *sub*, subumbrella; *rc*, ring canal; *v*, velum.

Fig. 15. The basal portion of a tentacle.

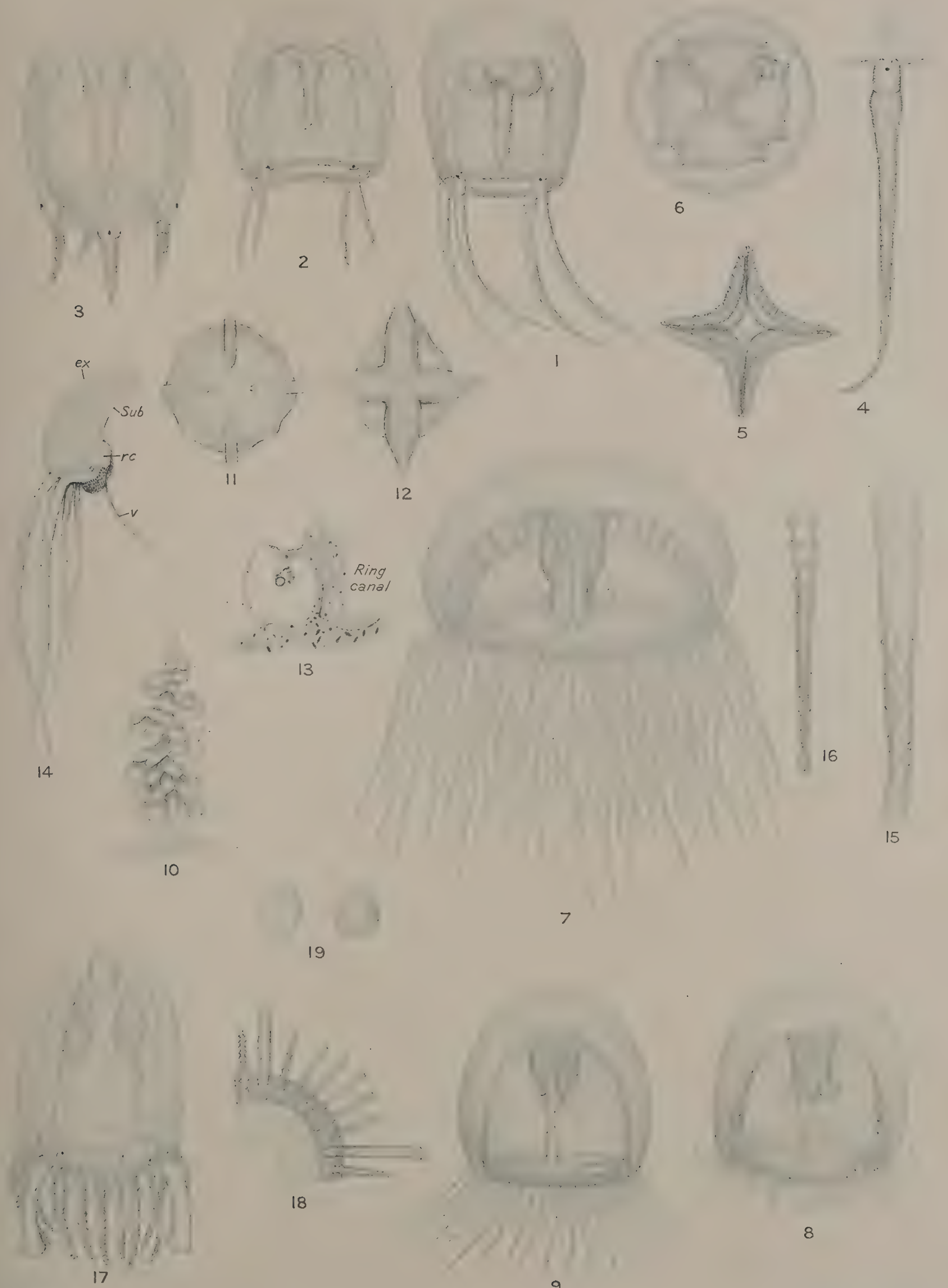
Fig. 16. The terminal portion of a tentacle.

Figs. 17–19. *Vallentinia falklandica* Browne.

Fig. 17. Lateral view of type specimen.

Fig. 18. Diagram of one quadrant of the umbrella margin, showing the position of the tentacles.

Fig. 19. The adhesive disks of the perradial tentacles.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MEDUSAE FROM THE FALKLAND ISLANDS

PLATE XIX

Fig. 1. *Rathkea formosissima* (Browne). Lateral view of the manubrium; specimen with medusa-buds, showing the relation of the oral arms to the mouth.

Fig. 2. *Staurocladia vallentini* (Browne). A tentacle of a specimen collected in 1901.

Figs. 3–5. *Phialella falklandica* Browne.

Fig. 3. Tentacle and basal bulb, outer (abaxial) view.

Fig. 4. Terminal portion of a tentacle, expanded.

Fig. 5. Optical section of basal bulb.

Figs. 6–7. *Vallentinia falklandica* Browne.

Fig. 6. Upper part of young specimen, lateral view.

Fig. 7. Young specimen, aboral view.

Figs. 8–11. *Tiaricodon coeruleus* Browne.

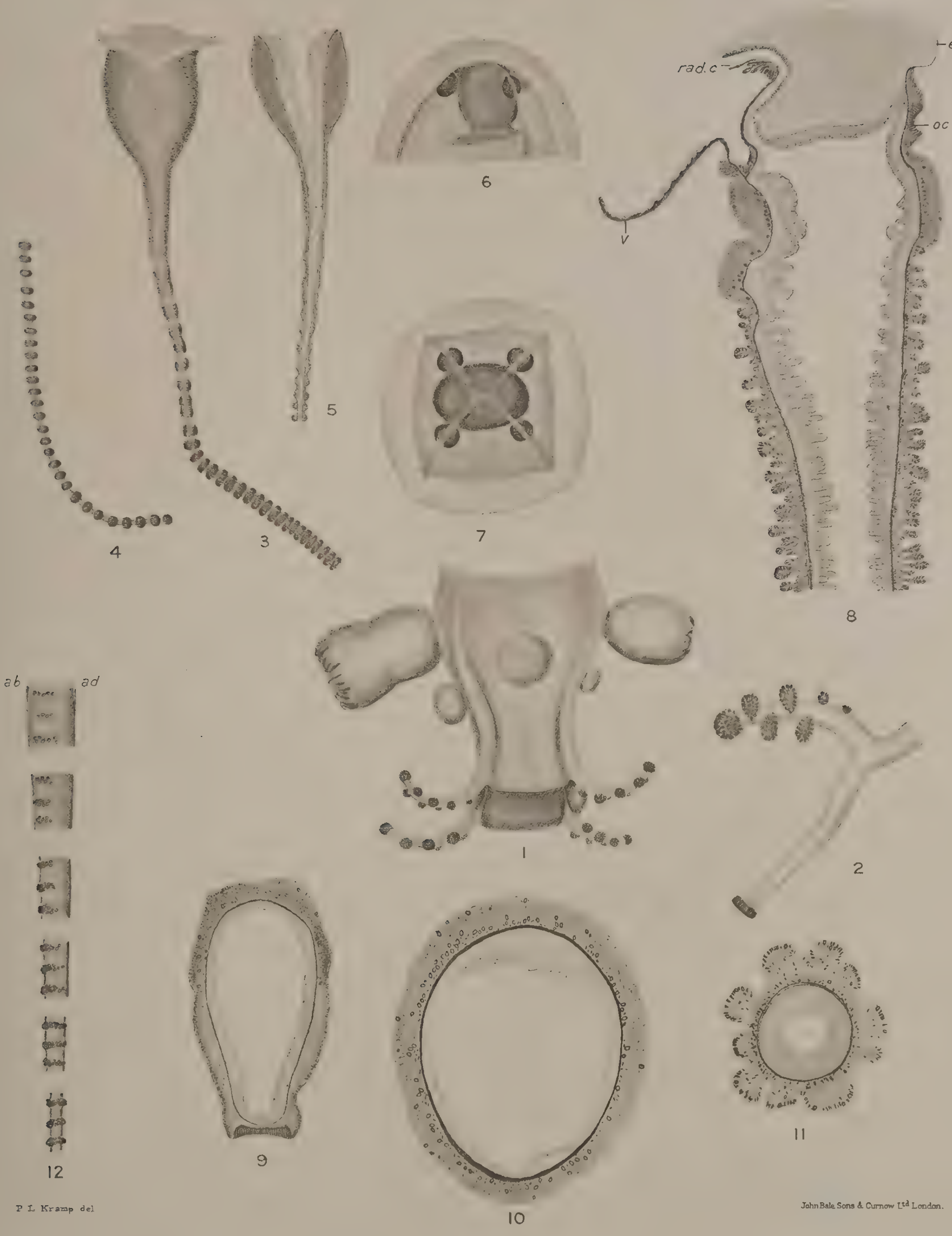
Fig. 8. Longitudinal section of basal bulb. *ex*, exumbrella; *oc*, ocellus; *rad.c.* radial canal; *v*, velum.

Fig. 9. Transverse section of basal bulb at the level of the ocellus.

Fig. 10. Transverse section of basal bulb, the thickened part beyond the ocellus.

Fig. 11. Transverse section of tentacle, median portion, showing clusters of nematocysts.

Fig. 12. *Willia mutabilis* Browne. Six portions of a tentacle, from the basal to the distal part, showing the clusters of nematocysts. *ab*, abaxial side; *ad*, adaxial side.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MEDUSAE FROM THE FALKLAND ISLANDS

[*Discovery Reports. Vol. XVIII, pp.* 323–338, *Plates XX–XXI, November* 1939.]

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MADREPORARIAN CORALS, WITH AN ACCOUNT OF VARIATION IN *CARYOPHYLLIA*

By

J. STANLEY GARDINER, M.A., F.R.S.

MADREPORARIAN CORALS, WITH AN ACCOUNT OF VARIATION IN *CARYOPHYLLIA*

By J. Stanley Gardiner, M.A., F.R.S.

(Plates XX–XXI)

THE corals described in this report were collected by the scientific staff of the Discovery Committee between the years 1926 and 1933. The following localities are represented:

Gough Island, St. 399.
Tristan da Cunha and Inaccessible Island, Sts. 6, 1187.
Cape Lopez, French Congo, St. 279.
Annobon, Gulf of Guinea, St. 283.
New Zealand—North Island, St. 939.
South Georgia and Shag Rocks, Sts. 152, 160.
Clarence Island, St. 170.
Palmer Archipelago, Sts. 181, 182, 190.
Cape Horn, St. 388.
Patagonian Shelf, Falkland Islands, and Burdwood Bank, Sts. WS 76–99, WS 210–250, WS 792–871.

Further information is given in the Station Lists issued by the Discovery Committee.

Corals were obtained in 34 dredgings and these have been referred to 14 species in 9 genera. In each of 29 dredgings only a single species was obtained, in 4 two species and in 1 three species. On the other hand, *Flabellum curvatum* was obtained in 17 dredgings, 79 to 278 m., and *Balanophyllia cornu* in 6 dredgings, 75 to 404 m.; these are Moseley's Challenger species, which were obtained respectively from off Rio de la Plata, 600 fm., and off Ki Islands, 129 fm. Of the rest 4 species were each obtained from two dredgings and 1 from three. I can recall from no expedition any analogy to the wide distribution in its area of *Flabellum curvatum*, of which 158 coralla were obtained. A search for characters in these which might be supposed to be related with a low temperature, as the one non-fluctuating feature in their localities, proved unavailing; indeed, they presented no differences in texture compared with *F. rubrum* and *pavoninum*, of which I have had large numbers of specimens from the Indian Ocean. Of other species Moseley's *Caryophyllia profunda* is at present only known from the Antarctic, as are two species of *Gardineria*.

The identification of the specimens of *Caryophyllia* led me to a consideration of taxonomic characters in this genus. The examination of the collection in the British Museum was of great value, for which I thank Captain Totton. Co-types of Pourtalès were kindly supplied to me by the Agassiz Museum for which I have to thank Dr Barber, the Director; they will be added to the British Museum collections; they cause me to admire and feel confidence in Pourtalès' work.

The Director of Research has kindly allowed me to insert in this Report an account of *Turbinolia australiensis* n.sp., the first species of the genus obtained alive.

LIST OF SPECIES

- Fam. FLABELLIDAE.
  - *Flabellum harmeri* Gard.
  - *F. curvatum* Moseley.
  - *Gardineria antarctica* Gard.
  - *G. lilliei* Gard.
- Fam. TURBINOLIDAE.
  - *Desmophyllum capense* Gard.
  - *Caryophyllia cyathus* (E. and S.).
  - *C. profunda* Moseley.
  - *C. arcuata* Ed. and H.
- Fam. TURBINOLIDAE.
  - *Caryophyllia mabahithi* Gard. and Waugh.
  - *Turbinolia australiensis* n.sp.
  - *Sphenotrochus intermedius* (Munster).
  - *Deltocyathus lens* Alcock.
- Fam. STYLOPHORIDAE.
  - *Madracis decactis* (Lyman).
- Fam. EUPSAMMIDAE.
  - *Dendrophyllia oahensis* Vaughan.
  - *Balanophyllia cornu* (Moseley).

Genus **Flabellum**[1]

The corals of this genus have no theca and hence no costae, no pali and no columella, any central filling in being by trabeculae from the larger septa. Its epithecal wall is little thickened, except where the internal polyp is stimulated by destruction of the same to deposit additional corallum to heal the wounds. In growth it precedes the formation of septa and, externally, commonly shows rather irregular transverse lines of growth. Some species remain attached, others become detached, while in a third group (cp. *rubrum*) the coral breaks off above its basal attachment leaving a distinct scar showing 1 or 2 cycles of septa; very exceptionally the third method may be found in a species which normally is attached or free (cp. *curvatum* below). The number and size of the septal cycles vary, but hexamery is universal, no variation having been found either in young or old. The septa increase by the formation of new cycles during growth, these appearing as two new septa on either side of each septum of the last formed cycle, viz. alternating with the pre-existing septa. Each species aims at a definite number of cycles, but this is occasionally passed in the species with flattened calices by the formation of new septa on either side of the terminal directive septa, these being necessary for the filling up of gaps in the calices, in which the septa are always regularly spaced.

Flabellum harmeri Gardiner.

Brit. Ant. (*'Terra Nova'*) *Exp.* 1910, Zool. v, 122, I 19–20 (1929).

St. 170, 342 m.

A single dead specimen, 49 mm. high, calice 56 × 25 mm., summits of side walls 12 mm. higher than ends, 24 larger and equal septa and cycles I–V complete with at the ends of the calice some of cycle VI. No trabeculae in the axial fossa are visible from the surface. The base is broken across and there are 12 septa in the section. The strongest features of separation from *curvatum* below lie in the size, the equality of septa I–III and the greater compression. The outside of the column is largely covered by growths of Polyzoa and one end of the calice has been broken and regenerated. There are about 16 growth rings on the epitheca.

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[1] For a general consideration of the genus and some species I may refer to *Marine Inv. S. Africa*, II, 5–54, I–IV, 1902 and *Rec. Ind. Mus.* pp. 301–16 (1929). I have examined the polyps of several species without finding specific characteristics in the polyps other than those indicated by their coralla.

Flabellum curvatum Moseley (Pl. XX, figs. 1, 2).

'*Challenger*' *Rep.* p. 174, VI 2 (1881).

The series comprises 159 specimens dried, and a number in spirit, well preserved.

The polyps show a deep purple rim round the peristome where the tentacles rise, the other parts being less coloured; the pigment is gradually soluble in alcohol so that the whole polyp may be lightly coloured. The tentacles are tightly set with nematocysts at their ends and are found over all septa except those of the last formed cycle.

The corallum is a flattened cone with no side wings; it becomes detached from its original support and lies freely on the bottom. The calicular opening is about 100 to 65, length to breadth. The epitheca usually shows transverse growth ridges.

The rim of the epitheca forms a slight upstanding wall above the edges of the septa, which never rise above it. In the smaller specimens 12 equal septa regularly fuse by trabeculae to fill in the central valley of the calice at about half its depth. In larger specimens septa III are usually joined to these, but are narrower and thinner, their trabeculae extending inwards at a deeper level. In median-sized forms four cycles of septa are present, but in larger specimens septa V appear and, when this cycle is complete, 1–4 or more pairs of VI may form, usually near the directives. Growth ridges are distinct on the septal sides and are set with spines; the result is a rough appearance of the septa, the edges of which may show fine serrations.

Every individual coral varies in its axial valley, the trabecular floor of which usually lies at a depth of one to two-thirds the height of the corallum. Septa I and II slope to this level almost perpendicularly, and the false columella formed by their trabeculae varies greatly in breadth and coarseness of structure; its formation is very little assisted by extensions from septa III.

The extreme height of the specimens is 48 mm., calicular length 36 mm. While plenty of specimens show curving, this is never as extreme as in Moseley's eight specimens which were dredged at 600 fm. off the Rio de la Plata. The external decomposition of the epitheca is as Moseley described, and this makes visible the septa below as ridges down the same.

The wide distribution of these corals shown below suggests that we are dealing with a definite species, the variation of which will now be clear. There may be several synonyms, previously described species, or it may be a synonym of one of these, but no such relationship is clear.

LOCALITIES: St. WS 76, 207–205 m., 1, 20 mm. high by calice opening 22 × 15 mm., 12 septa solidly fused in centre, cycle V almost complete: St. WS 80, 152–156 m., 1 large and 2 small: St. WS 83, 137–129 m., 3, with calices 17, 16 and 12,[1] in larger cycle V considerably developed: St. WS 85, 79 m., 3 young: St. WS 92, 145–143 m.,

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[1] Such single measurements are the maximal along the calicular opening.

1, 16 mm. long: St. 182, 278–500 m., 18 and 15 mm., long, rather thin coralla: St. WS 210, 161 m., 1 young: St. WS 212, 242–249 m., 25, 21 and 11 mm., delicate: St. WS 216, 219–133 m., 26, half vary 22–30 mm., rest grading up in size from 3·5 mm. with 12 septa not yet joined and 5 mm. 20 septa: St. WS 237, 150–256 m., 1 dead and 1 young: St. WS 243, 144 m., 1 young: St. WS 244, 253–247 m., 1 of 18 mm., 11 small grading from 18 septa, these coralla open in centre, 6 still attached: St. WS 247, 172 m., heavy massive form, 27 mm. high, 27 × 17 mm. calice, septa I and II alone fused in centre, this most exceptional for the size: St. 652, 164 m., 69, very uniform between 12 and 19 mm. in calicular length, 12 septa fusing, 4 cycles complete and some of V, many attached to pebbles, all somewhat eroded outside, most 5 or 6 growth rings: St. WS 792, 102–112 m., 1 large of 33 mm.: St. WS 795, 157–61 m., 6 large open forms up to 30 mm. with 3 attached young, smallest 3·5 m., 16 septa not joined: St. WS 839, 403–434 m. 1 of 46 mm. high, calice 28 × 21 m., epitheca markedly upstanding, 5 young corals attached: St. WS 867, 150 m., 27, similar to 652, more graded and open calices, smallest 5 mm. with 12 septa fusing and 12 of III.

Genus **Gardineria** Vaughan

Bull. U.S. Nat. Mus. no. 59, p. 65 (1907).
Duncania, Pourtalès, *Mem. Mus. Comp. Zool. Harvard*, IV, 44 (1874).

I have expressed the opinion that this genus should be absorbed into *Haplophyllia* on somewhat slight grounds.[1] Vaughan and Wells are considering the question of coral genera, and, to avoid confusion, it is better that I should retain the genus at present.

Gardineria antarctica Gardiner.

Brit. Ant. ('*Terra Nova*') *Exp.* 1910, Zool. v, 124, I 11–18 (1929).

A single specimen, calice 17 × 15 mm. across, was obtained from St. 190, 90–130 m.; it is closest to Fig. 14 above, the columella-pillars being even more developed. In comparison with *G. capensis*[2] only 12 septa fuse to form the columella, and the septa do not rise above the rim of the calice. There are also two large dead specimens, somewhat decayed, from St. 152, 245 m.

Gardineria lilliei Gardiner.

Brit. Ant. ('*Terra Nova*') *Exp.* 1910, Zool. v, 125, I 3–10 (1929).

St. 140, 122–136 m., 1, 20 mm. high, broken calice with about 50 septa: St. 160, 177 m., (*a*) 2, large, 32 mm. high by 16 mm. across mouth of calice and 24 by 17 mm., (*b*) 2, about 13 and 10·5 across, (*c*) 12, smaller, averaging 24 by 9 mm., and (*d*) 20, still smaller forms: St. 181, 160–335 m., 2, 42 by 17 and 31 by 15 mm., one much curved: St. 190, 90–130 m., 1, 52 by 20 mm. The series contains 40 specimens, which were mostly attached to pebbles. They are upstanding cones, some a little bent, generally almost circular in section.

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[1] '*John Murray*' *Exp.* v, 173 (1938).

[2] *Duncania capensis*, *Marine Inv. S. Africa*, III, 120, I 6*a–c* (1904).

The original description is correct for the six corals collected by the 'Terra Nova', but requires qualifications if the present series is referred to *lilliei*, the only other course being to describe 4 new species on characters, which are believed to be dependent on growth as governed by environment.

The thin epitheca is a marked feature, but, as in the smaller forms from St. 160, there may be external erosion or the attachment of sedentary animals, either of which may induce a thickening of the epitheca by the internal deposition of corallum; these may also inhibit the broadening of the calice. The result of erosion is to show longitudinal striae corresponding to the internal septa. These cross the circular growth-markings, which for the intermediate series from St. 160 suggest 7–9 growth periods. The epithecal growth precedes the septal, so that the septa are never exsert.

Septa I and II (12), as a regular feature, meet deep down in the calice in a mass of twisted trabeculae. Then there are septa III and IV; the latter are incomplete only in the smaller forms, and there are as many septa of V as the available interseptal gaps allow, the earlier septa showing little thickening. In the smaller forms the edges of the septa are untoothed and the sides almost smooth, but in the two larger from St. 160 they are studded with low spines.

The size and depth of the trabecular, and hence false, columella depends largely on the shape of the corallite, in tall forms of small diameter being scarcely visible. The two low forms of St. 160 (*b*) are relatively shallow with 3 and 2 twisted trabecular pillars standing up on the false columella; these have 4 cycles of septa.

The specimen from St. 190 is a very clean and rapidly grown form; its septa are thin and tend to be wavy, while their fusion by trabeculae is so deep down as to be almost invisible. These characters are to a lesser degree seen in two similar specimens from St. 181.

Genus **Desmophyllum** (Ehr.) Ed. and H.

Desmophyllum capense Gardiner.

Marine Inv. S. Africa, III, 96 (1904).

St. WS 99, 251–225 m., 7 large specimens; St. WS 250, 257–313 m., 1, 45 mm. high by 32 mm. along the length of the calice, only commencing to show the vertical ridges characteristic of the larger forms.

Being doubtful as to the range of a species which may include *Desmophyllum christa-galli* Ed. and H.,[1] *D. ingens* Moseley[2] and the present forms I must retain this species.

The outer surfaces of the 7 coralla from St. 99 are swollen out into rounded ridges between the chief septa (I, II and III). Between these larger septa, in accordance with the interseptal gaps that these ridges may provide, are found septa of cycles IV, V, VI, VII and occasionally VIII. A specimen (co-type) of the *D. capense* before me has similar but lower ridges; its calicular opening measures 38 by 25 mm. and has a rather open centre. Four of the larger specimens above, 58 by 35 mm., 48 by 30 mm., 75 by 45 mm. and 58 by 35 mm., have 15, 18, 20 and 18 ridges; all are much closed in the centres of their calices by the inner edges of the packed and upstanding septa. The ridges extend down nearly to the bases of all four specimens. All are broken off by the trawls above their attachments, providing transverse sections; these show no endothecal trabeculae like dissepiments, except in one specimen, which is decayed in its lower parts, and here they are most irregular but useful in strengthening the corallum. Trabeculae may join together the larger septa in the centre of the corallum, thus producing a certain obliteration of such axial space as exists.

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[1] *Vide* Duncan, *Trans. Zool. Soc.* 1873, p. 321, XLI 10–16 and Marenzeller, '*Valdivia*' *Exp.* p. 267, XV 2 (1904); the resemblance of the present species to the forms figured in 2 and 2*b* is obvious.

[2] '*Challenger*' *Rep.* p. 160 (1881).

The coralla would seem to form clusters, but there is no suggestion of other than an adventitious association of polyps. There is little internal thickening of the theca, but the edge zone of the polyp, as far down as it persists, would seem to be depositing corallum on the same and thus filling in the intercostal spaces. The specimens are much overgrown by worm tubes, by hydroids, etc., and the edge-zones of the polyps do not exist outside the theca for more than about 10 mm.

I have specimens of *Desmophyllum* before me identified by Pourtalès as *Desmophyllum christi-galli* Ed. and H., *Desmophyllum rusei*, *Desmophyllum cailleti* both Duch. and Mich., from the West Indies, also *Desmophyllum vitreum* Alcock; all of these on the material before me, I regard as good species. The constant difficulty in identification in genera such as this, with a growth to a large size, is a lack of knowledge as to whether any specimen is adult or immature. Judging by the ways of nature, there must be an immense mortality in the young, few surviving to the adult stage, one perhaps in 1000 or more.

Genus **Caryophyllia** Lam.

Caryophyllia cyathus (E. and S.).

Madrepora cyathus Ellis and Solander, *Nat. Hist. Zooph.* p. 150, XXVIII, 7 (1786); Ed. and H., *Ann. Sci. Nat.* ser. 3, IX, 287, IV, 1 (1848); Lacaze-Duthiers, *Arch. Zool. exp. gen.*, ser. 3, XV, 12–91 (1897); Marenzeller, '*Valdivia*' *Exp.* p. 295, XVI 6 (1904); Döderlein, *Mit. Zool. Sta. Neapel*, XXI, 117, VII 1, 2 (1913).

There is much confusion in literature between three of the earlier described, larger species. The aim in growth of *clavus* is 16 pali, while in *cyathus* and *smithi* it is 24, the same number as is sought for in *grandis*,[1] which is founded on a series of 71 specimens, all markedly cornute and mostly lying unattached upon the bottom. The specimens of *smithi* that I have examined do not exceed 15 mm. in diameter, whereas *cyathus* is much larger. *C. profunda*, also with 24 pali, differs in the great thickness and exsertness of septa I–III and in its columella being more deeply situated and in consequence smaller. It is just conceivable that these three species are environmental variations of *cyathus*, but details of surface structure do not support this suggestion.

All the present specimens are attached forms. Each has a relatively broad base, an even column for about two-thirds of its height ending in a spreading out, slightly compressed and shallow calice; the thick column is due to an extensive deposit of corallum outside its theca. Low costae, their surface finely granular, corresponding to the cycles of septa, extend down as far as the polyps, viz. to the part where the calice enlarges. The septa vary in thickness and exsertness according to their cycles, of which I to III are approximately equal in the larger specimens; all are relatively little exsert, the largest seldom extending more than 2 mm. above the theca. All the septa are relatively smooth and thin. The trabeculae joining I–III to the columella are generally clearly visible in surface view.

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[1] '*John Murray*' *Exp.* v, 117, I 2 (1938).

The aim in growth is 24 pali situated before septal cycle IV, plates very slightly thicker than the septa and relatively smooth; they are joined by trabeculae to the columella. The columella consists of relatively thin, twisted ribbons, the number of which varies with the compression and depth of the calice but is always large. The surface of the columella is upstanding and rather domed.

St. 190, 315 m., largest 33 mm. high and 24 × 21 mm. in diameter of calice, 20 pali, 80 septa, septa and costae less differentiated than in the figures of Ed. and H. but very closely resembling those of Marenzeller. The next is 34 and 22 × 18 mm. with 24 pali, and there are 7 smaller specimens and many fragments.

St. 399, 141–102 m.; a specimen 4 cm. high, calice 32 by 24 mm. much thickened by worm tubes at its base.

Caryophyllia profunda Moseley.

Moseley, '*Challenger*' *Exp.* p. 138, I 6 (1881); Gardiner, *Trans. Roy. Soc. Edinb.* XLIX, 688 (1913).

St. 6, 80–140 m., 12 corallites. The largest specimen is 37 mm. high and 25 × 19 mm. in diameter of calice, 12 septa especially prominent both in thickness and in exsertness, 20 thin plate-like pali, septa to correspond; one specimen has calice twice as long as broad (20 × 10) with 16 pali and all costae well marked and the smallest calice is 9 mm. in diameter with 12 pali. All show a similar differentiation in septal size and the costae are in prominent cycles; the smaller specimens have relatively thicker pali. The remarks in the second reference above on the specimens from the Scottish National Antarctic Expedition apply equally well to the present specimens. All have relatively smooth septa, not heavily spined, and trabeculae joining septa I–III to the columella are seldom visible in surface view.

St. 1187, 135–134 m. A corallum which had become attached to some solid body and grown up for 5 cm. into a bent horn, its calice 27 × 19 mm.; it has 21 pali. A second has become attached to the side of the same and grown up for 3·7 cm., its calice nearly round, 17 mm. across, septa thinner and less exsert, 24 pali; were the two not joined this latter corallum might well have been ascribed to *C. cyathus* above. Also a dead specimen attached to a pebble which has become overgrown by a polyzoon.

Caryophyllia arcuata (Ed. and H.).

Ed. and H., *Ann. Sci. Nat.*, ser. 3, IX, 290 (1898); Cor. II, 16 (1857).

Lacaze-Duthiers, *Arch. Zool. Exp. gen.* ser. 3, XV, 91–107, V (1897); Gravier, *Res. Camp. Sci. Monaco*, LV, 25, II 26–9 (1920).

St. 190, 315 m. Two broken off specimens fall within the redescription of this species by Lacaze-Duthiers, who had a suite of over 20 specimens. They are nearly round with rather shallow calices, closed by a large number of columella-rods. The pali in each number 12. The shape is cornute, and the polyp tissues extend for 3 to 4 mm. only down the outside of the corallum. Septa I and II are equal and markedly more exsert. The details of structure, especially of the pali, almost exactly resemble Lacaze-Duthiers' fig. 7.

Caryophyllia mabahithi Gardiner and Waugh.

'*John Murray*' *Exp.* v, 178, III 6 (1938).

St. 182, 278 m., 3 specimens, one being dead and one with regenerated calice.

Caryophyllia sp.

St. 279, 58–67 m., one specimen the shape and size of the last. It would seem to be a stage in the growth of a form that will have 12 pali.

Genus **Turbinolia** (Ed. and H.)

Ed. and H., *British Fossil Corals*, XVI, 13–21 (1840); *Ann. Sci. nat.*, ser. 3, pp. 235–40 (1848); Cor. II, 60–65 (1857).

Quayle, *San Diego Soc. Nat. Hist.* VII, 91–110 (1932).[1]

The genus is best known from the Eocene and Oligocene, the only possible recent species being *T. corbicula* Pour.[2] dredged in the Gulf of Mexico from 100 and 220 fm. and characterized as "perhaps fossil (?)". Most species are well illustrated and show a tendency or an actual fusion of septa III to septa I; in *T. costata* we suspect that Ed. and H. in the *Annales* (p. 239) has confused the cycles of septa, their description in Cor. II, 64, omitting all reference to this matter. The European species show the primary septa fusing with the columella, which ends in an upstanding column. The American species have these septa rising higher and running into the columella, to the surface of which they give a stellate appearance (cf. Quayle). The species below has a rather depressed columella with no style, but the primary septa rise well above the level of the theca and fall to their fusion with the columella; it is thus almost intermediate between the two groups. In all species there is a tendency for the septa of the last-formed cycle to be represented at first only by their costal portions, a character especially marked in the species below.

Turbinolia australiensis n.sp. (Pl. XXI, figs. 1 and 2).

Three specimens, 3–4 mm. high, nearly round with calices about 2 mm. in diameter, were presented to the museum at Cambridge in 1892 together with a collection of Polyzoa dredged in or near Port Jackson, New South Wales. They have now been presented to the British Museum.

About 12 costae at the base, additional costae forming higher up and corresponding to the new septa; no special costae over the directives and all relatively smooth, thick and well marked with deep intercostal valleys.

[1] See here for references to Vaughan and others up to date.

[2] *Bull. Mus. Comp. Zool. Harvard*, v, 203 (1878).

Six septa (I) thicker and fused in the centre of the calice. The next six (II) much thinner, extending about two-thirds of the way to the centre. Twelve (III) still thinner and joining septa I at about two-fifths of their breadth. Lastly, cycle IV generally represented only by costae, alternating with those of I, II and III.

Upper edges of all septa rising above the theca evenly. Septa of I with markedly upstanding edges, extending from the fusion with septa III almost to the depressed columella in the centre of the calice.

Genus **Sphenotrochus** Ed. and H.

Sphenotrochus intermedius (Munster).

Ed. and H., *Ann. Sci. nat.* ser. 3, IX, 243 (1848); Cor. II, 68 (1857). Duncan, *Trans. Zool. Soc.* VIII, 320, XLI 1–5 (1873).[1]

St. 388, 121 m., 7, one alive and the rest recently dead; St. 934, 100 m., one living, 11 mm. high with calice 7 by 3 mm.

A series of much larger coralla than those of the '*John Murray*' *Expedition* (p. 192), the living form from St. 388 being 7 mm. high, calicle 6 by 2·5 mm., the dead forms from same larger. There are three cycles of septa complete and in the larger forms the directive septa at the ends of the elongated calice may have pairs of septa IV on either side, in one corallum even some of septa V while at the sides of the calice there are only septa I–III.

The costae are well marked; new costae may look as if they arose by branching of the lower costae, viz. those near the base of the corallum, but the terminal costae belonging to the directive septa at the ends of the flattened calices never branch and are very conspicuous. The columella is a central plate along the calice and is joined by the ends of septa I and II; it is capped by a series of upstanding, rather rough pillars, shown best in the two living forms.

Genus **Deltocyathus** Ed. and H.

Deltocyathus lens Alcock.

'*Siboga*' *Exp.* p. 19, II 16 (1902).

A single specimen from St. 939, 87 m. It is a corallum that has regenerated from a broken fragment with 7 costae. The chevron-formation of the septa is little marked.

Genus **Madracis** Ed. and H.

The genus may be branching, or incrusting, or a mixture of both. The surface is covered with calices which are closely packed and small. The septal number is ten of equal size, all fusing internally with a styliform-columella. The calices are closed in below by tabulae regularly arranged as transverse partitions, and there is no other filling up of their cavities.

The above characters apply to the following species: *asperula* Ed. and H., *hellana* Ed. and H., *decactis* (Lyman) Verrill, *pharensis* Doderlein and *singularis* Rehberg, if my identifications are correct, and, as far as they are described, to various fossil species of Vaughan and others. *M. kauaiensis* Vaughan has 10 smaller septa of a second cycle, not reaching the columella. The cyclical number of ten is most important, the newly formed calices having no intervening stage with six septa so far as can be seen from an examination of budding.

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[1] Duncan's figures illustrate the shape and texture well. I expect Marenzeller's *aurantiacus* ('*Valdivia*' *Exp.* p. 280, XVIII 15) is a synonym, but I have not a long enough series to be assured. The same remark applies to *S. auritus* Pourtalès ('*Hasslar*' *Exp.* p. 37, 1874).

The genus varies in growth-form from fine branches to upstanding nodules or branches on a completely incrusting base. The latter may show no such upgrowths and may reach a considerable thickness so that the coral would be termed massive. Finally, in the lower parts of colonies the calices may be separated relatively widely by coenenchyma, this studded with low spines. The calices vary up to 3 mm. diameter. They may be divided by a thin sharp-edged upstanding theca or this may be quite thick and rounded, the whole perhaps flattened so as to give a depressed appearance. The presence of low, projecting rods around the top of the theca is usually a specific character, but an appearance of a few such may occur in any species.

The genus, as defined above, does not allow the retention of *Madracis scotiae* which I described in the account of the corals of the Scottish Antarctic Expedition in 1913; this has 8 septa, but definitely passes through a six stage. Probably it should be referred to *Axhelia* Ed. and H.

Madracis decactis (Lym.) Ver.

Pourtalès, *Ill. Cat. Mus. Comp. Zool. Harvard*, IV, 67, VII 1–3 (1871); Verrill, *Zool. Bermudas*, I, 108 (1903).

A single mass with irregular surface 6 by 4·5 cm. and 4·5 cm. high from St. 283, near Annobon Island, is referred here. Below its surface for 4 to 6 mm. the corallum is intact; this sits upon several layers of skeleton much decayed owing to the action of boring organisms. The calices are seldom more than 2 mm. in diameter; they may be crowded together and smaller where growth is active, these having thin, thecal walls. In hollows the calicular centres are somewhat separated, the theca greatly thickened, generally marked on the surface by a single row of blunt spines. Budding occurs on the edge and on actively growing knobs where three calices meet; in these it is very rare to find less than 10 septa if the theca is perfect. The columella is always present, but it is seldom surrounded by a circle of paliform-teeth.

The species described by Rehberg (*Abh. Nat. Ver., Hamburg*, XII, 10, I 3, 4, 1892) as *M. singularis* seems to fall within the range of *decactis*; it was obtained at 80 fm., at Fiji. Some calices in the present specimen are identical with those figured by Rehberg.

Genus **Dendrophyllia** (Blainville), Ed. and H.

Dendrophyllia oahensis Vaughan.

Bull. U.S. Nat. Mus. no. 59, p. 154, XLVI 1 (1907).

St. WS 244, 253–247 m.

Seven small colonies are here assigned, largely on the faith of Vaughan's photographs, of which one shows the costae and another brings out the very characteristic kind of network fusion together of the septa to form a thick wall. All have a semi-upright growth ringed in places and some colonies show thin epithecal coverings. The columella varies greatly; it may be small and situated rather deeply, especially where the edge of the calice is bent in, or may be quite shallow, extending for half the length of the slightly compressed calice where the edge is straight or spreading. Dead calices with budded off polyps on their sides, still alive, may obtain a diameter of 13 mm., but the ordinary large calice is not more than 9 mm.

Genus **Balanophyllia** Ed. and H.

Balanophyllia cornu (Moseley).

'*Challenger*' *Rep.* p. 192, text-fig. and XII 11–15 (1885).

St. WS 83, 75 m., 2 attached coralla with broad bases; St. WS 93, 133–130 m., 6 coralla all living and attached, largest 15 mm. long diameter of calicular opening; St WS 243, 144–141 m. 3 cornute forms, unattached, varying up to 13 mm. diameter; St. WS 246, 267–208 m., 5 cornute forms, 3 free up to 17 mm.; St. 839, 404–424 m., 1 bent, free, cornute form of 22 m.; St. WS 871, 336–341 m., 4 forms, 2 free, largest 23 mm.

We have before us 21 coralla of the present collection from 6 stations, 3 from the 'John Murray' collection 229 m., and the 3 'Challenger' types from Ki Islands, 129 fm. The latter have a dense heavy corallum with well-marked costae from calice to base and the largest, a dead specimen, has distinct trace of an epitheca. All except three of our specimens show an epitheca and some would be described as of the *Thecopsammia*-facies. It is best marked, thicker and with transverse growth-lines, in the largest specimens, on which it most closely approaches to the calicular margin. There is a less definite edge to the theca in some specimens than in the types due to a spongy arrangement of trabeculae. Generally the costae are not well-marked, in no specimen as prominent as in the types, but then the present specimens have not the same firm coralla.

The important, specific character lies in the arrangement of the septa, which Moseley has shown in his text-figure and which we have not found in other large *Balanophyllia*. There are no prominent exsert septa or groups of septa. Septa I and II are quite separable and at a deep level run into the columella. Septa III, IV and V are as shown by Moseley and any variation in any other septa is in correlation with the depth of the upstanding columella in the axial fossa, a matter which every growth-form settles for itself. It is especially deep in the two small type-specimens and is always a more or less upstanding mass of twisted ribbons, its size variable.

All the polyps of our specimens as preserved were of a deep brown colour. Their surfaces and internal anatomy were irretrievably damaged. Those from St. WS 93 are recorded as having a yellow corona when alive which we think refers to the lighter peristome, rather more marked around the edge of the stomodoeum. Whether the ascription of our very variable set of specimens to *B. cornu* is correct or not we cannot say, but they draw attention to an arrangement of septa that may form a sub-section of the genus. We have only found it recorded elsewhere in "Doderlein's figs. 81, 82",[1] reputed *B. italica*, which must be contrasted with his figs. 79, 80 and 84 which show the more usual fusing of septa; this species is markedly compressed and the edge of its calice arched by the exsert ends of septa I and II.

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[1] *Mitt. Zool. Sta. Neapel*, XXI, IX (1918).

VARIATION IN THE GENUS **Caryophyllia** Lam.[1]

Corals of this genus may be regarded as central to the Turbinolidae, since species are described in the reports of nearly every expedition that has indulged in deep-sea collecting in whatever seas it has worked. The genus is hence cosmopolitan, and its species can obviously withstand large ranges of temperature and salinity. Fossil forms are widely distributed in suitable tertiary deposits, but have been described also from the cretaceous. While the existing species are mainly inhabitants of waters deeper than 50 fm., which is about the limit of plant life, a few species occur up to the tidal areas.

Now, all modern reports on corals and many other marine animals are based on a supposition of gradual migration from shallow to deep seas. If this be the case, some changes common to the skeletons of corals might be expected, the coralla perhaps becoming thinner and more delicate while still quite suitable to the calmer, deeper and colder waters. Examining living and fossil forms, I have not found such changes within genera, perhaps owing to my having had too frequently to draw my own conclusions as to the ecological conditions, which the living and now fossil corals had to face. Indeed, when I study reports on the species of *Caryophyllia*, I find that my difficulties as to the determination of specific characters and as to the range of variation in fossil and living forms are precisely the same. The study of the oecological conditions of living forms does not help much, for the information as to the nature of the bottom where they lived, and of the temperature, salinity and movements of the overlying waters is scanty. Furthermore, the study of shallow-water forms gives the impression that corals which are detritus-feeders and possess no symbiotic algae, have a wide tolerance of fluctuation in these. Using, as we must, the criteria of anatomy, especially that of living forms, it would seem abundantly clear that many, perhaps most, fossil forms of *Caryophyllia* still continue to exist to-day, in spite of the millions of generations that may have intervened since their deposits were laid down.

The skeleton of a coral gives no suggestion as to whether its polyp was adult, viz.

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[1] The reader *inter alia* should consult the '*John Murray*' *Exp. Rep.* v, no. 7, 1938 in which 55 out of 511 *Caryophyllia*, belonging to 6 species, are illustrated. Some remarks in this report (p. 169) are here more carefully discussed after a renewed examination of the same specimens, helped by the specimens below and many types and other supposed species in the British Museum. The Agassiz Museum, Harvard University, has most generously sent me co-types of Pourtalès' species. Among Duncan's types of corals, which Capt. Totton has discovered to have been deposited in the British Museum under a different name from Duncan, those from the 'Porcupine' Expedition (*Trans. Zool. Soc.* 1873 and 1878) include 10 "species" of *Caryophyllia* each determined on a single specimen and 8 of these described as new. From the discussion below, it will be clear that none of these can in my view be accepted. I have found Seguenza's plates of his 47 fossil forms (*Mem. Real. Acad. Sci.*, *Torino*, ser. II, 1864) and certain other palaeo-zoological literature most illuminating; *Ceratocyathus* is a synonym. *C. cyathus* and *profunda* have been left in this Report as two distinct species, because I have no series from the original locality of the former and no information as to the environment from which my specimens were taken.

reproducing or not, though with a long series a size is reached beyond which there is little further growth.[1] *Caryophyllia* starts as a polyp of even diameter, developing below it a "basal plate" of corallum on which a cycle of six radiating plates, the primary septa, are deposited. These grow in height, while their sides thicken, along a circle close to their external edges, to produce a ring-like theca, the whole standing up into the base of the polyp. I have found it to be a rule in *Caryophyllia*—and indeed in most or all coral genera—that, in growth, spaces between septa, if sufficiently wide, are invariably filled by the formation of more septa, which at once connect with the theca, indeed often seeming to be formed on its upper edge. Thus there are progressively added, as the polyp grows, the septa of cycles II (6), III (12), IV (24) and so on.

Each species of *Caryophyllia* aims at some definite number of septa and, as the septa at all levels of the skeleton are about equidistant from one another, the corallum has to increase its diameter. This is usually met by the assumption of a horn-like (cornute) shape, but the young polyp may have broadened its basal attachment, so as to allow gaps for septal cycles II and III before upright growth is established.[2] In many species this cornute-growth may be masked by the broadening of the whole stem. This is accomplished by the deposition of corallum between and over the outside edges of the septal plates—these are the costae—so as to form a thick wall of solid corallum on the outer side of the circular thecal growth, which is otherwise unaffected; thereby the diameter of the column may be increased several times. For this deposition the polyp tissues outside the corallum are responsible. Such soft parts are easily killed, especially by silt, with the cessation of further skeletal formation, and the naked column then becomes subject to solution and the ravages of boring and other animals. The result may be that a species, which normally grows a broad, straight stem, may become quite cornute, but of course in truly cornute species there is no such thickening.

Irregularities in growth may take place in all corals and a common development is the assumption of an oval or compressed shape of calice, which in *Caryophyllia* may be fixed as a specific character. In these species or specimens, as the septa do not become curved in any way, spaces may be left at the ends of the compressed cup. A method here is to form 2 pairs of septa of a new cycle on either side of each terminal or directive septum of cycle I. All the septa here placed then gradually approximate in size to those of existing septa and may be classified into their cycles so that the hexasymmetry is altered; this is well seen in *C. clavus* (Scacchi) which usually has 16 systems.[3] *C. octopali*

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[1] Cf. *Flabellum* in "Protandry and Senescence in Corals" (*Proc. Camb. Phil. Soc.* XI, 463–71, 1902) and *Marine Inv. in S. Africa*, II, 115–54, 1902. *F. curvatum* in the present report lends support to the "size" question.

[2] A growth vertical to the base of attachment is found in the early stages of all corals and is presumably correlated with feeding in the detritus-layer; it is well seen in shallow-water *Paracyathus*. Disc-like genera later spread horizontally, but the correlation of septal formation to available gaps formed between septa applies to all.

[3] The greatest irregularities occur in the details of this growth in corals, whose compression seems to be a matter of environment rather than of descent and is hence not a specific character. Even in the latter two new systems may form first at one end of a calice or even one at each end, an additional two systems appearing more slowly in later growth.

Vaughan and *C. mabahithi* G. and Waugh have 8 systems and no conspicuously compressed shape of calice, this character here appearing to be genetical.

In this consideration the existence of the pali is helpful, the rule in the genus being a series of larger septa (6, 8, 12, 16 or 24 in different species) without pali, each separated from its neighbour by three septa, the middle one of which has a palus internally—each system has four septa, viz. the dividing septum and these three. There is no great variation in growth,[1] but it would seem that the numbers of septa and pali are genetical in each species and that the polyp will build to this end, overcoming by a variety of means all difficulties of growth.

Of the other characters of *Caryophyllia* the columella, which exists in all stages of growth, is formed usually of twisted, somewhat flattened rods often termed ribbons, varying in their shape and number with the form and size of the central space between the inner ends of the septa. Sections suggest that there is the formation of one column on the basal plate, additional ribbons appearing as space allows. The presence or absence of costae together with their size and spininess, the exsertness and surface characters of septa, etc., scarcely require comment as these vary greatly with the environment and consequently with the rate of growth of each corallum. An interesting feature of growth is that, with increase of size of the corallum, there is not a proportionate thickening of septa and other parts of the skeleton, although these are covered by the formative tissues. Making certain generally accepted assumptions, such as (1) an increased metabolism of the polyp in proportion to size, (2) the formation of the skeleton in proportion to such metabolism, and (3) the coupling of reproductive activities with a considerable lessening of growth, it is so difficult to understand this cessation of skeleton-deposition that our somewhat mechanical assumptions would appear unjustified.

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[1] Sometimes a palus fuses with its septum which then may be classified as the septum of a previous cycle; the old system divides symmetrically and the two new systems are perfected by the formation of a pair of septa in each; the middle septum of each acquires a new palus.

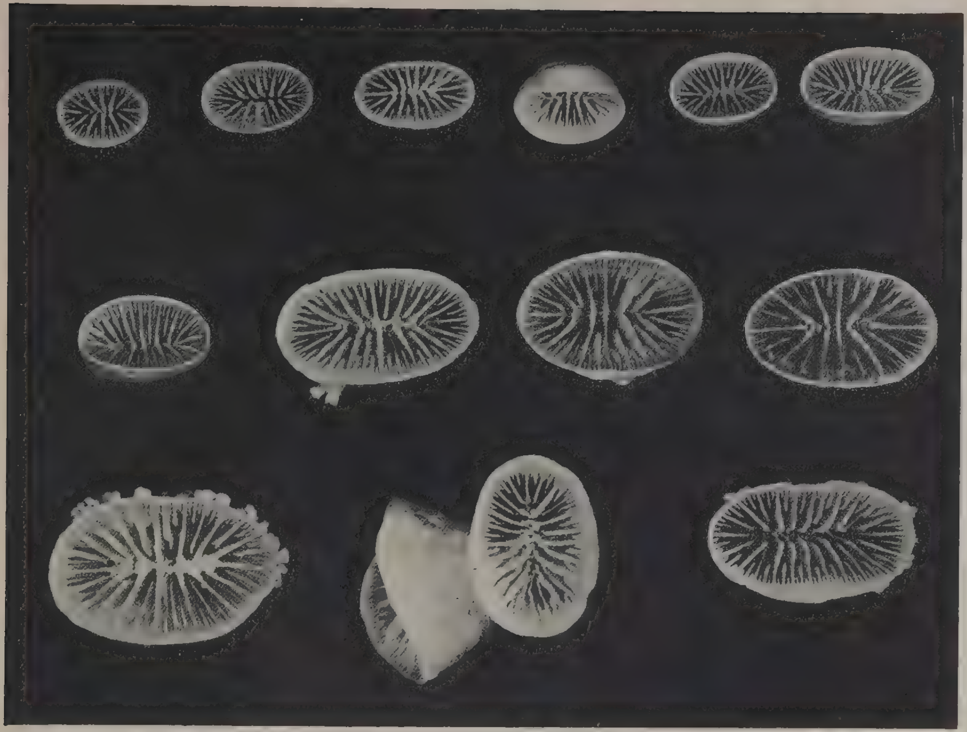
[illegible]

PLATE XX

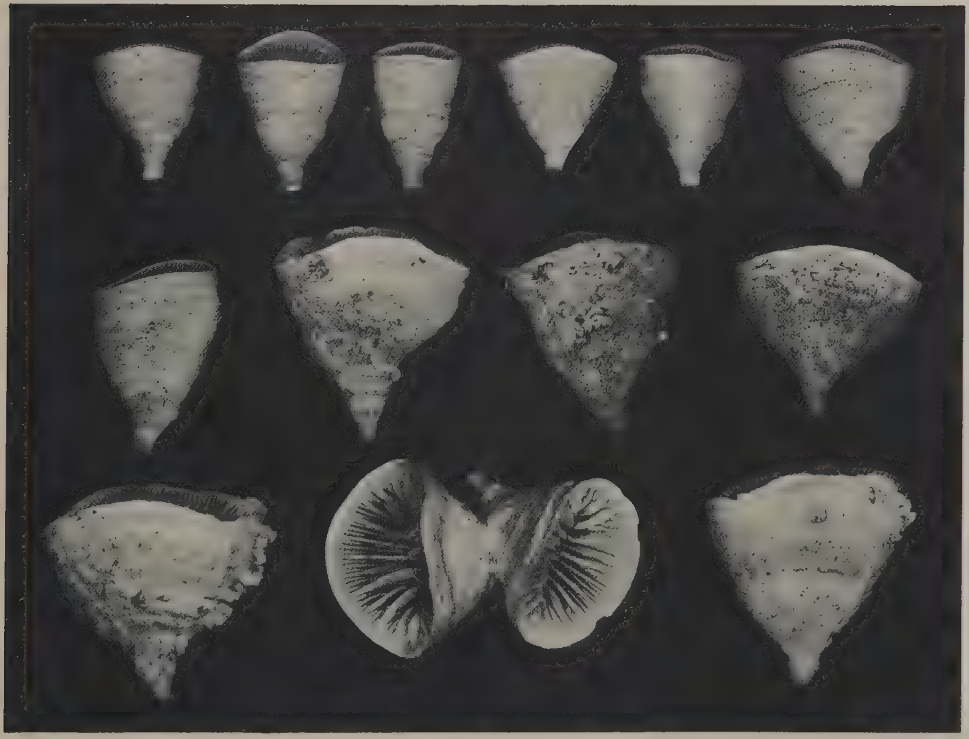
Flabellum curvatum Moseley. × 1.

Fig. 1. Surface view. Fig. 2. Side view.

Top row from St. 652. Middle row, specimen to left St. 216 and to right St. 247, the two central St. WS 795. Lower row, specimen to left St. 792, rest St. 795.



1



2

John Bale, Sons & Curnow, L^td London.

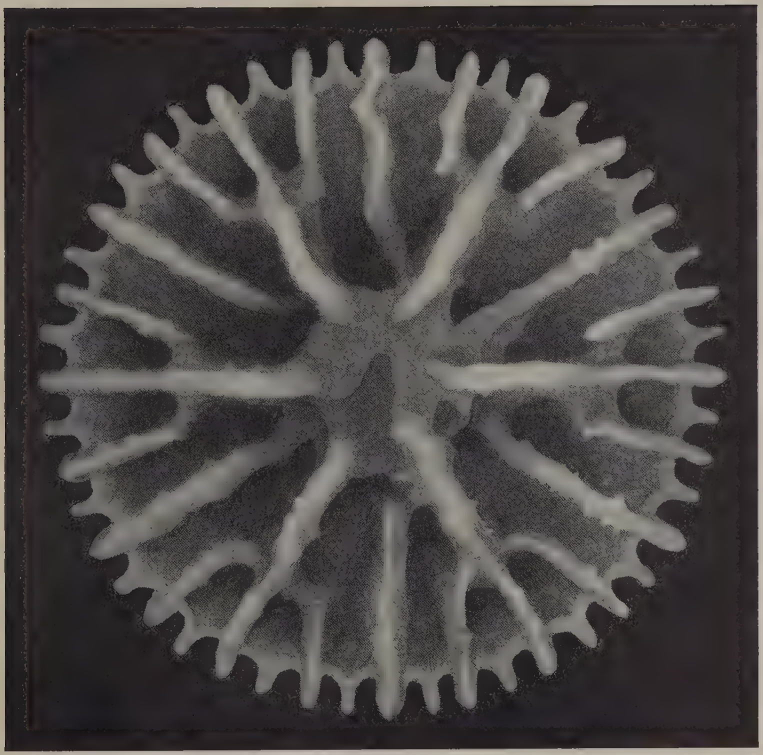
FLABELLUM CURVATUM

PLATE XXI

Turbinola australiensis, n.sp.

Fig. 1. Side view.

Fig. 2. Surface view.



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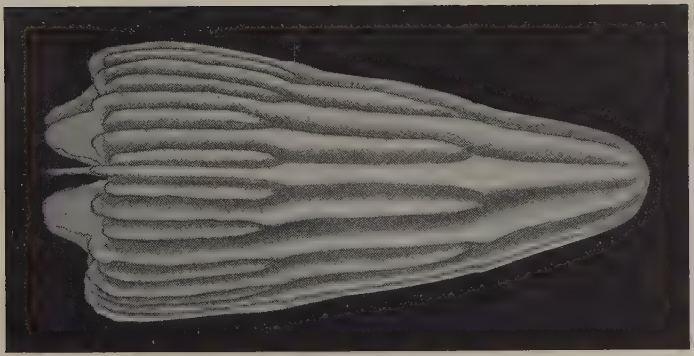

1

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